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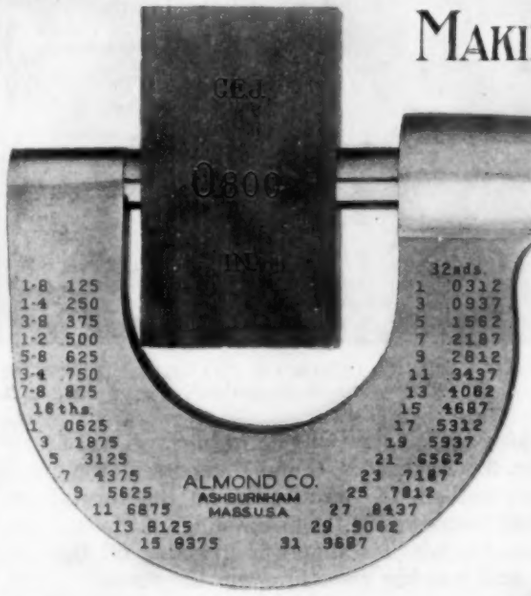
Making The Almond Micrometer



By

Ethan Viall

Editor American Machinist

While we can illustrate some of the mechanical processes through which the parts of a micrometer go, we cannot illustrate the infinite care and workmanship that accompany each step. It requires work to almost the nth degree, in order that cumulative errors may not spoil the final result.

THERE is no more universally used instrument of precision than the micrometer. What was but a few years ago considered to be of use only to the toolmaker is now part of the kit of, or is used by, machine shop workers from the most inexperienced cub to the all-around old timer and expert. The workman of today has been so educated that he thinks and talks in thousandths and ten thousandths of an inch. This has been brought about by his constant use of micrometers.

Naturally in making an instrument of such precision, careful workmanship and a considerable percentage of high-grade workmen must be employed. This means that the skill of the worker is at least as important a factor as the jigs and tools he uses. In other words, the tools and methods described in this article, while good in themselves, would be almost useless unless handled by properly trained mechanics.

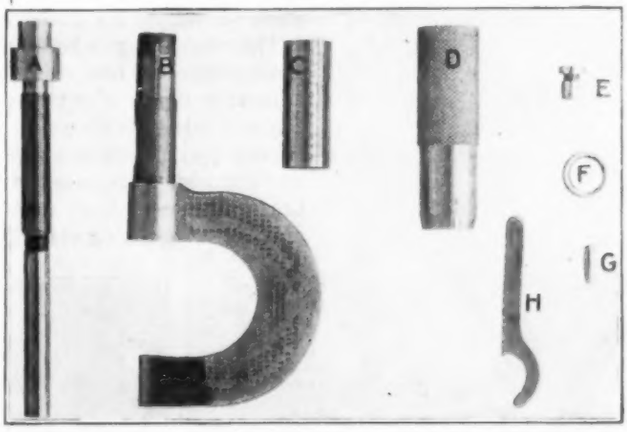


FIG. 1. COMPONENT PARTS OF AN ALMOND MICROMETER

The T. R. Almond Manufacturing Co., Ashburnham, Mass., makes both inside and outside micrometers, but only the production of the principal parts for outside micrometers will be touched upon. These micrometers are made regularly in ½- to 24-in. sizes, and have drop-forged frames in the smaller sizes, and screws with buttress threads. A one-inch micrometer is shown in the headpiece, and its component parts in Fig. 1. In this illustration *A* is the screw and spindle, which are made of one solid piece of tool steel. *B* is the frame; *C* the sleeve; *D* the barrel, or thimble; *E* the anvil; *F* the adjusting nut;

FIG. 2. ASSEMBLY OF 1-IN. MICROMETER WITH PLAIN FRAME

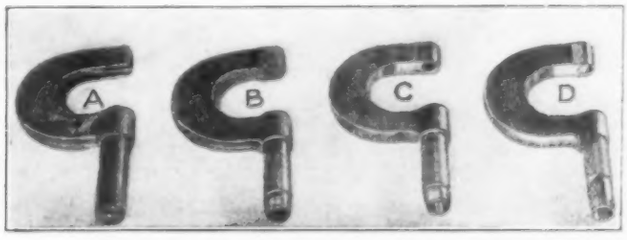


FIG. 3. A FEW STEPS IN FRAME WORK

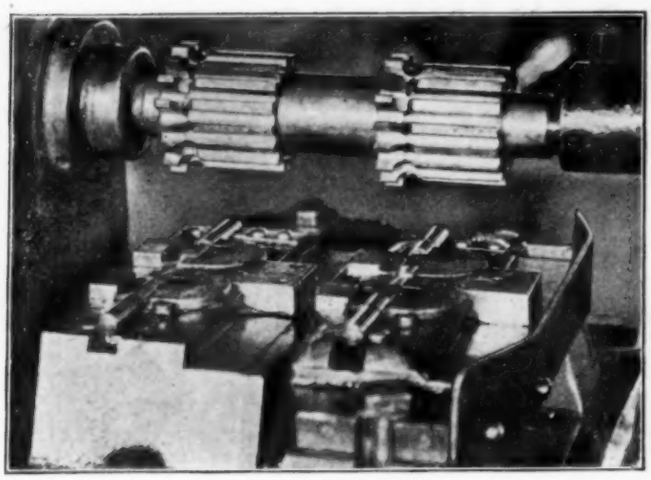


FIG. 4. MILLING SIDES OF FRAMES

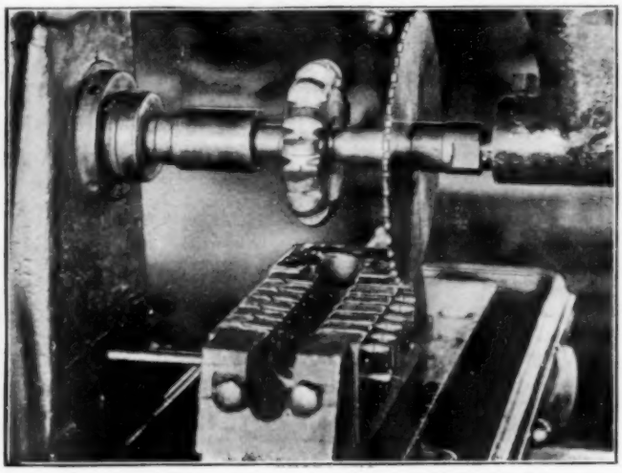


FIG. 5. MILLING INSIDE OF FRAMES AND CUTTING ENDS OF STEMS

G the sleeve tension spring and *H* the adjusting wrench. An assembly drawing of a 1-in. micrometer with plain frame is shown in Fig. 2.

Machining Micrometer Frames

It must be kept in mind that every part of a micrometer must be finished with the greatest care, so that in the final assembly the accumulative result will be satisfactory. On a drop-forged frame, the operations are:

1. Snagging.
2. Milling sides.
3. Milling inside and cutting off end of stem.
4. Drilling, rough-turning, cutting thread.
5. Recessing hole.
6. Reaming hole.
7. Tapping.
8. Splitting.
9. Taking off burrs.
10. Finish turning.
11. Milling recess for tension spring.
12. Drilling anvil hole.
13. Reaming anvil hole.
14. Polishing.
15. Etching.
16. Assembling.

Taking these operations up in turn, we will first refer to Fig. 3. Here *A*, *B*, *C* and *D* represent the principal, though not all, of the steps from the forging to the finished frame ready for assembling.

Snagging consists simply in grinding off the forging flash and roughly smoothing up the frame. Next the frames are placed, four at a time, in the jig shown in Fig. 4, and the sides milled. As both sides have to be milled, two frames are finished at each pass of the formed cutters.

The inside of the frame is milled and the end of the stem is cut off as shown in Fig. 5. The holder is a simple form of clamping jig made up of stationary end pieces and sliding formed jaw-blocks. The frames, six at a time, are placed between these formed blocks and clamped in place by tightening the screws in the end piece shown in the foreground.

The next thing is to drill the spindle hole, rough-turn the outside of the stem and thread the end for the adjusting ring. For this purpose the frame is put into a turret lathe, as shown in Fig. 6. The frame is located in the spindle fixture by means of the milled inside surface which fits over a formed and hardened block on the stationary "jaw" of the holder. A simple formed and screw-operated clamping block keeps the frame in

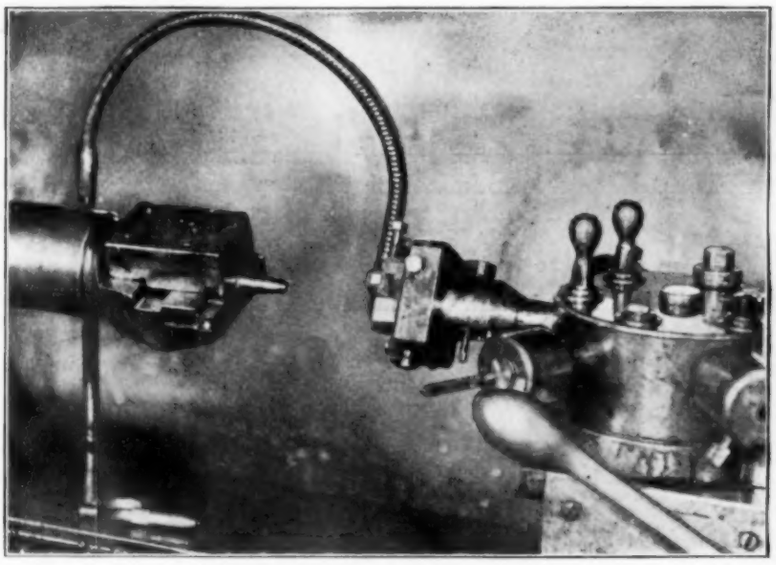


FIG. 6. ROUGHING OUT THE STEMS

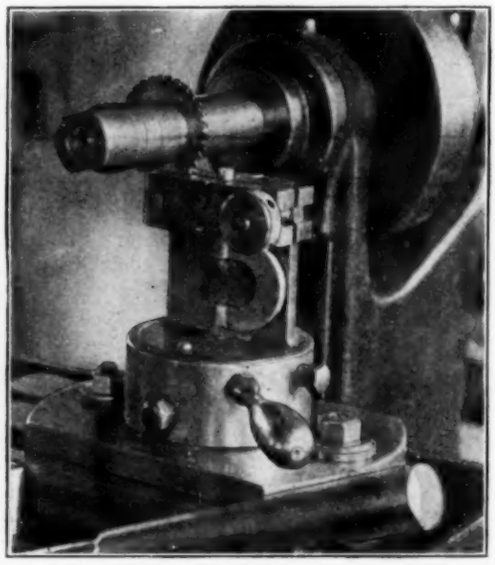


FIG. 7. SLITTING THE END OF A STEM

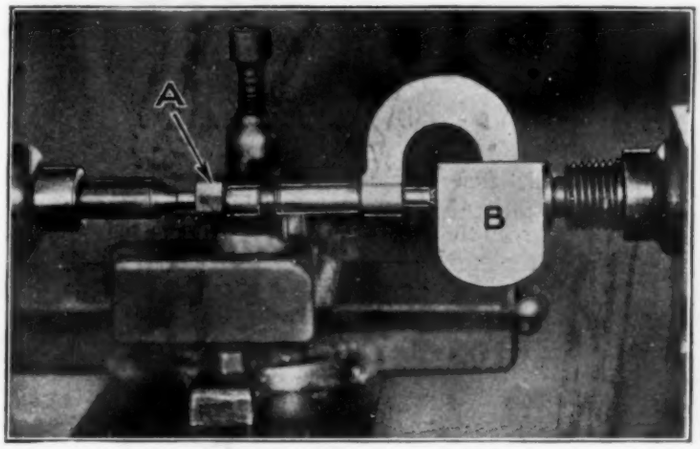


FIG. 8. FINISH TURNING OUTSIDE OF STEM

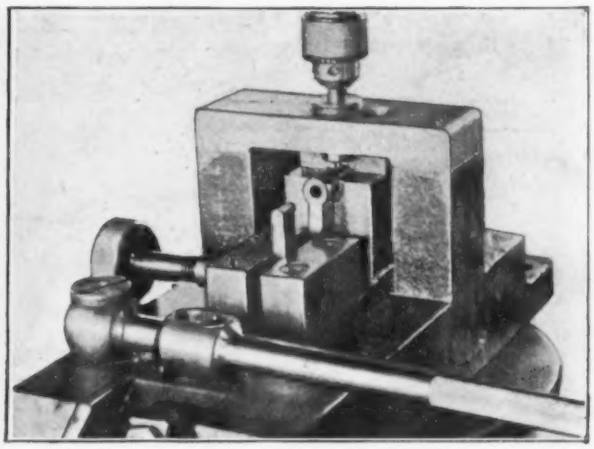


FIG. 9. MILLING RECESS FOR SLEEVE TENSION SPRING

place. The rough-turning is done with a box tool and the threading with a self-opening die head. The hole is next hand-reamed to size and recessed for clearance. Following this the buttress threads for the screw are tapped by hand with a piloted tap.

The tapped end of the stem is split to allow for adjustment, as shown in Fig. 7. The frame is held by the stem in a hinged clamp which is locked by means of a knurled hand nut. Proper height of the work in the jig is secured by means of a hardened screw head on which the frame rests. One cut is made and then the jig is indexed a quarter turn for the other cut. This divides the end into four parts.

Finish Turning Frame

The burrs are removed by hand and then the frame is ready for finish-turning the outside of the stem in a small lathe. For this work the frame is placed on a mandrel. A knurled "draw-in" nut *A*, Fig. 8, pulls the stem to a seat at both ends. The work is driven by the "dog" *B* which has a recess into which the end of the frame fits.

The recess in the stem for the tension spring is milled as indicated in Fig. 9. The frame is located and clamped as shown, and the recess is milled out with an end mill guided by a bushing in the top cross-piece of the jig. After the mill is fed down to the proper depth the length of the slot is secured by movement of the hand lever.

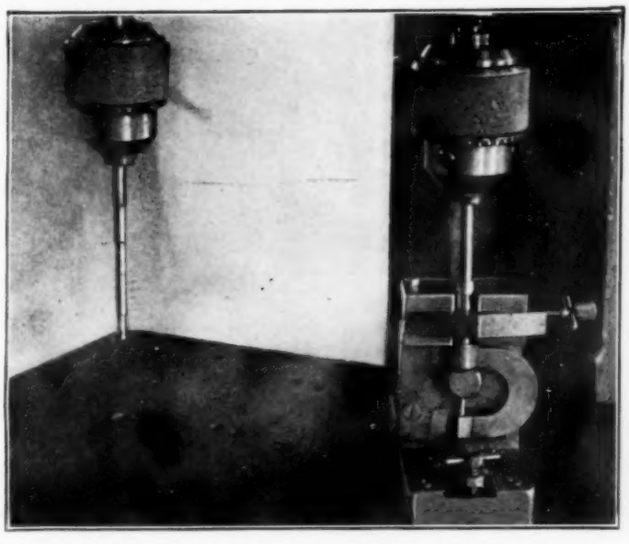


FIG. 10. DRILLING AND REAMING ANVIL HOLE

While listed as separate operations, the drilling and reaming of the anvil hole are done in a two-spindle drilling machine. The frame is held in a jig, as shown at the right in Fig. 10, and the hole is drilled. The jig is next moved over and the hole line reamed with the reamer shown at the left.

The frame is now polished and the figures etched on it. This etching is accomplished by coating the surface of the sides and cutting in the characters on a multiple pantagraph machine, after which acid is used to etch the characters into the metal.

Machining the Spindles

As has been previously mentioned the spindles and screws are made of one solid piece of tool steel.

A spindle is first roughed out from the bar in a screw machine, and the small end centered. The piece is then

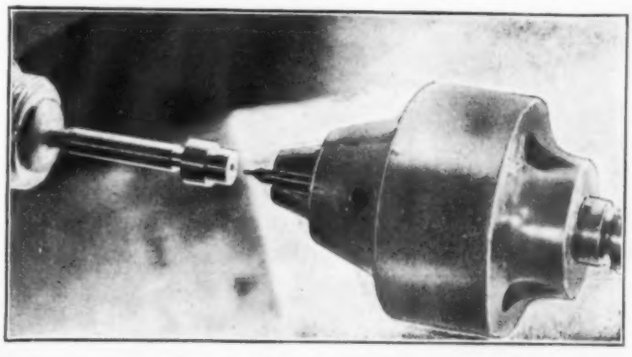


FIG. 11. CENTERING LARGE END OF SPINDLE

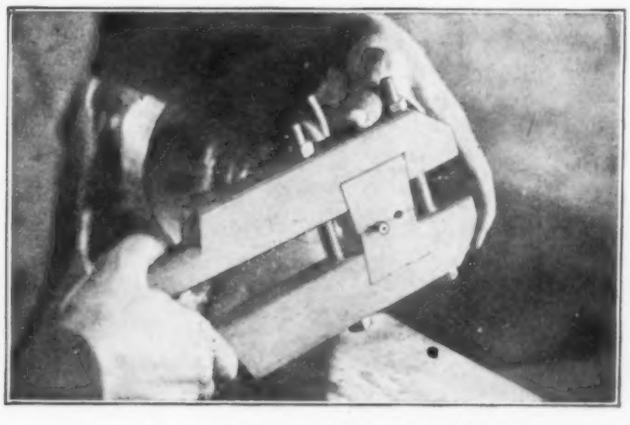


FIG. 12. LAPPING OUTSIDE OF SPINDLE

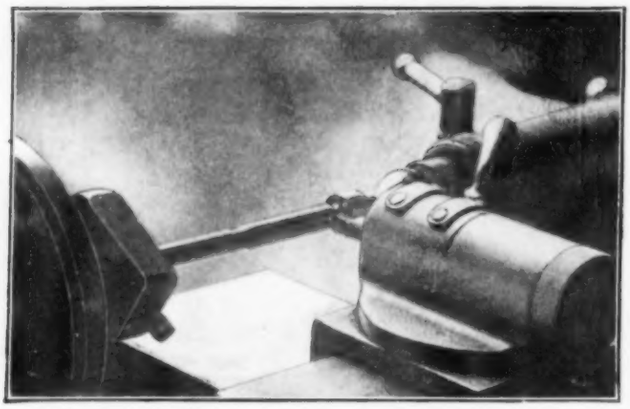


FIG. 13. FINISH-TURNING SPINDLE FOR THREADING

placed in the collet chuck of a small lathe and the large end centered, as shown in Fig. 11.

The small end is next hardened and then the spindle is ground on centers in a grinding machine. Following this it is lapped to size in a small lathe as shown in Fig. 12. The laps are lead blocks, charged with fine abrasive, held in a wooden clamp as shown.

The part of the spindle on which the thread is to be cut is next turned to size in a bench lathe, Fig. 13. The spindle is now ready for turning the thread, which is one of the most particular jobs imaginable.

THE THREAD CUTTING MACHINE

The thread cutting machine is shown in Fig. 14. The work to be threaded is shown at *A* and the threading tool at *B*. The threading tool has only a cross-feed movement, as the work is fed past it. The lead screw is cut directly on the lathe spindle at *C*, and feeds through the split nut *D* which is set into the bearing or pillow block *E*. The tail spindle *F* is counterweighted and slides in the split bearing *G* as the work is fed forward or back. In putting in or removing the work the tail spindle may be locked out of contact by pushing it back until the latch *H* drops into the notch *I*. The work to be turned is carried on centers and driven by a small dog so adjusted as to eliminate play. The lead screw is of the same lead as the thread cut on the micrometer spindle, which is 40 threads per inch. This lead screw is cut as accurately as it is possible to cut a screw and it took several months to get one uniform enough for the purpose. However, differences of temperature make it necessary to provide some means of compensating for changes in the lead. The same mechanism can, of

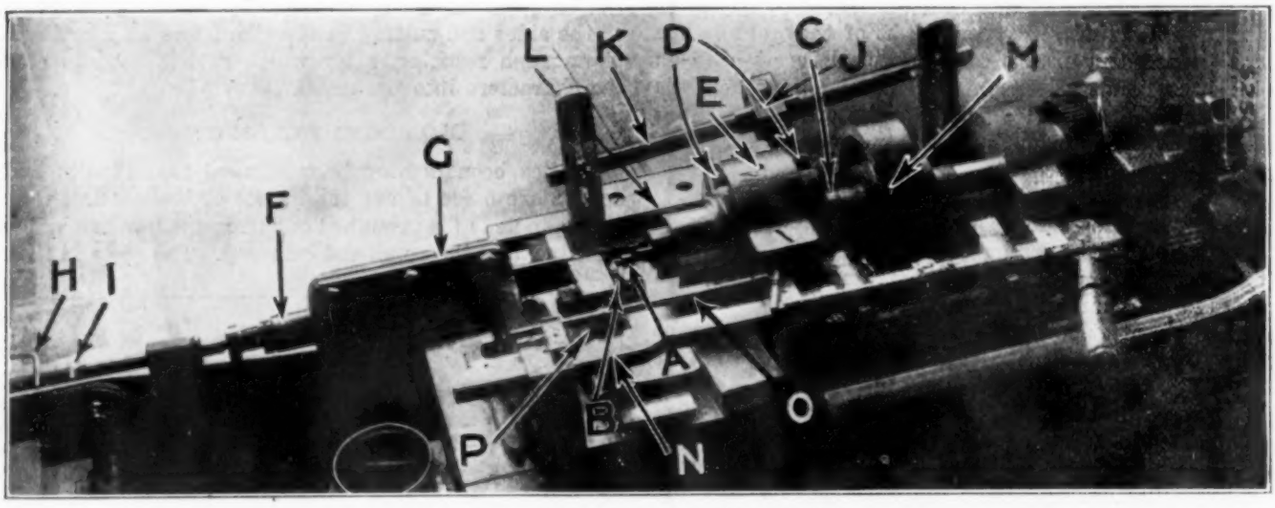


FIG. 14. THE SCREW CUTTING MACHINE

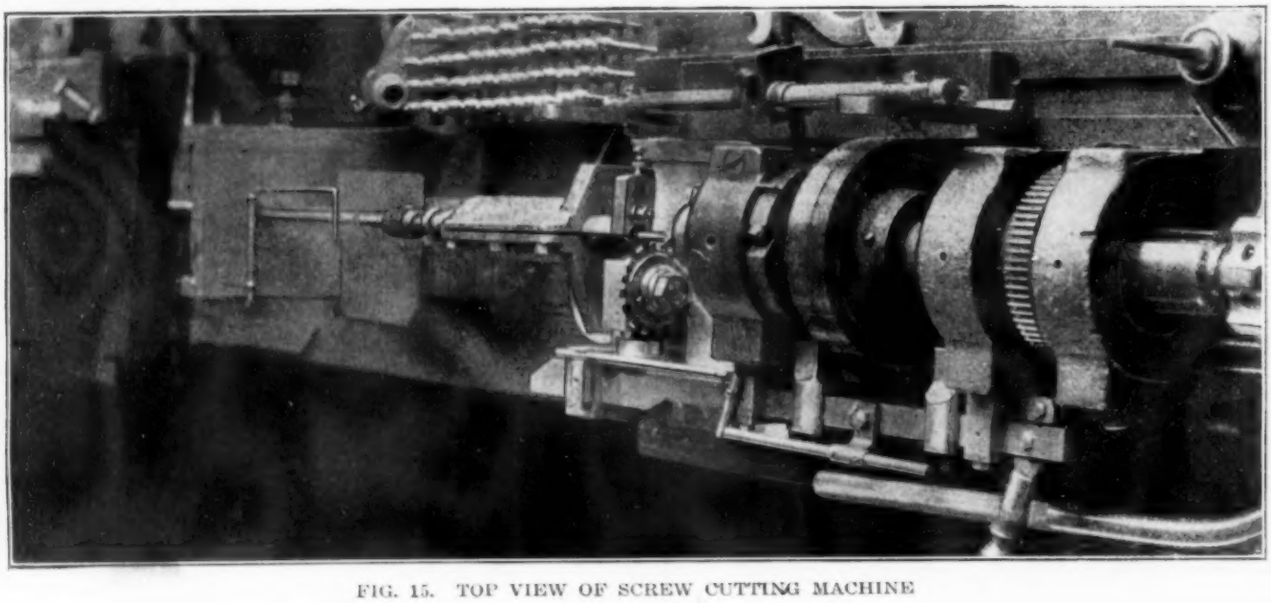


FIG. 15. TOP VIEW OF SCREW CUTTING MACHINE

course, be used to offset the errors caused by a screw that leads too fast or too slow. The method employed is to mount the lead screw nut in a pillow block, as previously mentioned, in such a way as to eliminate all end play but leave it free to rotate within certain limits. A bar screwed solidly into one flange of the nut connects it to the slide *J* on the bar *K*. It will be seen that the greater the angle at which bar *K* is set, the greater the amount which the nut *D* will be turned as the lathe spindle feeds the work past the threading tool. If the direction of rotation of the nuts is the same as that of the rotation of the lead screw, the lead of the thread cut will be lessened. If the nut is turned in the opposite direction to that in which the lead screw is turning, the lead of the thread being cut will be lengthened. However, as the length of thread cut, and consequently the lengthwise movement of the lathe spindle, is about $1\frac{3}{8}$ in., the distance traversed is not sufficient to give good results. To get around this condition a scheme is resorted to by which the bar *K* is given a movement parallel to the lathe spindle, at approximately three times the speed at which the spindle feeds forward or back. This is done by mounting the bar *K* on a slide having a rack *L* into which the threaded disk *M* meshes.

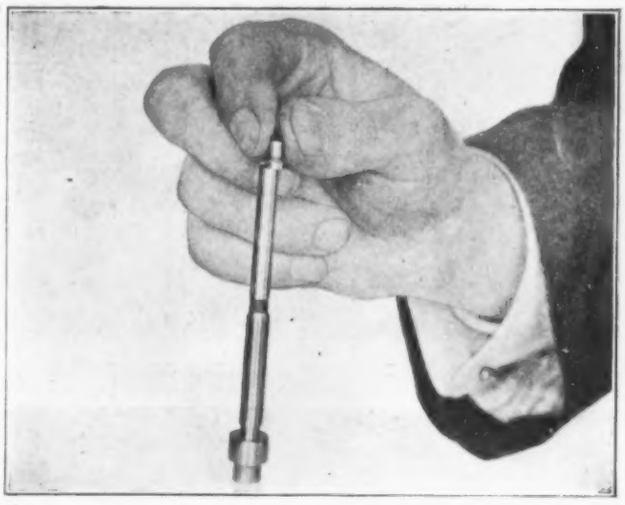


FIG. 20. ANVIL AND SPINDLE END WRUNG TOGETHER

will be seen that approximately three times the feed is given the rack *L* and compensating bar *K* as is given to the lathe spindle and work. In consequence, the lead screw nut is given approximately triple the movement it would have if the spindle movement alone was used, with the compensating bar *K* at the same angle. This avoids an excessively steep bar angle.

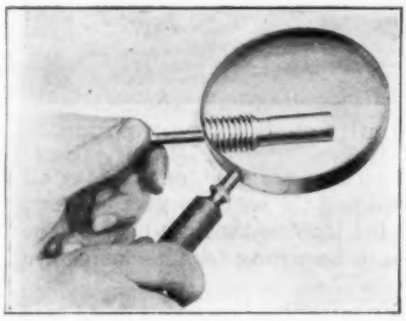


FIG. 16. MAGNIFIED VIEW OF SCREW THREAD

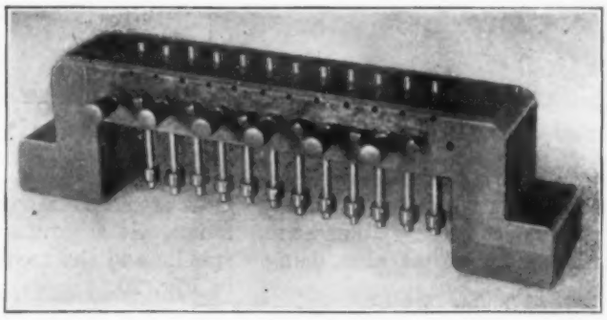


FIG. 17. SPINDLE END GRINDING JIG

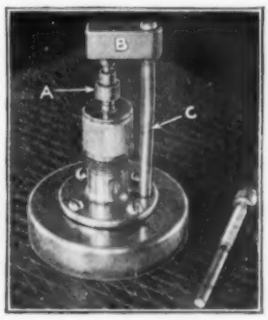


FIG. 18. THE SPINDLE END LAPPING JIG

This disk is keyed solidly to the lathe spindle but the thread on it is cut 12 to the inch, in contrast to the 40 to the inch thread on the spindle itself. Hence it

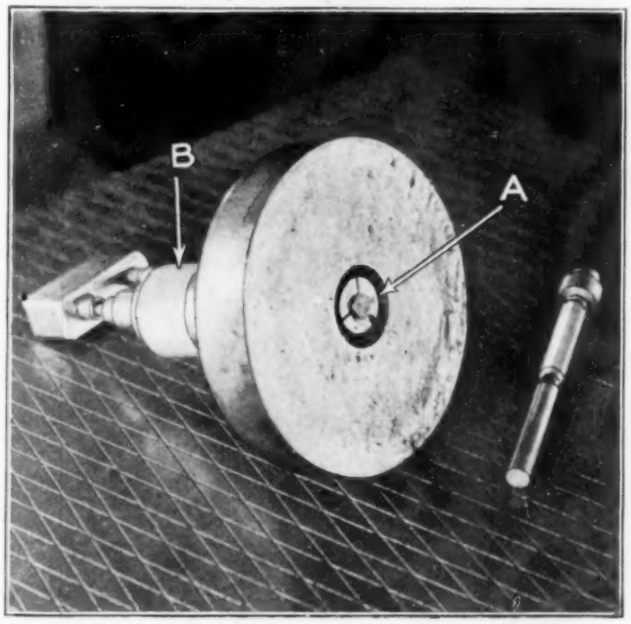


FIG. 19. BOTTOM OF SPINDLE END LAPPING JIG

In cutting threads it has been found that the angle at which compensating bar *K* has to be set varies considerably in hot summer and cold winter. Where temperature changes are sudden, the angle has to be adjusted from day to day, in order to obtain accurate results in the lead of the screw cut.

The thread on the lathe spindle is right hand and so is the thread cut on the micrometer spindle. This makes it necessary to set the threading tool up-side-down, but this has several advantages, one of which is that the chips more readily fall away from the cut.

After the lathe spindle has fed forward with the work on a cut, the bar *N* is automatically forced to the right by means of a stop and allows the tool carriage to slide back and the tool clear the work. The spindle then runs back to the starting point and another stop slides the bar *N* to the left which pushes the tool forward into the cutting position again. The cutting tool is fed forward the right amount for each individual cut by the ratchet action of the small sliding bar *O* which acts on a ratchet wheel *P* on the end of the feed screw.

Some of the mechanism described is more clearly shown in the top view of the same machine given in Fig. 15.

FIG. 21. REAMING OUT THE BARRELS OR THIMBLES

FIG. 22. FINISH-TURNING OUTSIDE OF BARRELS

FIG. 23. TURNING BEVEL ON END OF BARREL

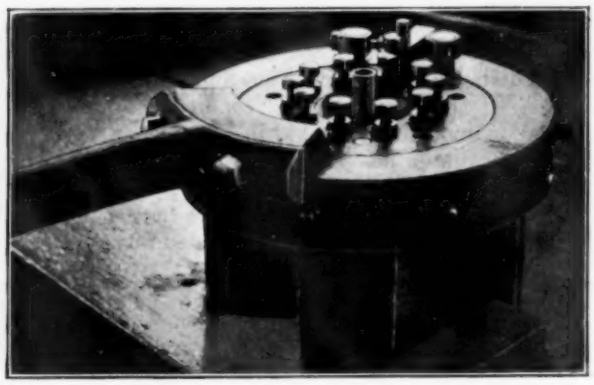


FIG. 24. STAMPING FIGURES ON THE BARREL

The way the thread cut on this machine looks when magnified is indicated in Fig. 16.

The hardened ends of the micrometer spindles are ground on an ordinary surface grinding machine, using the holding jig shown in Fig. 17.

The lapping of the spindle end is a real precision job. The spindle to be lapped is placed in the holder as shown at *A*, Fig. 18. The block *B* on part *C* may be swung around out of the way when putting in or taking out a spindle. The post has a limited amount of vertical spring movement and tends to press the spindle downward when in position.

A view of the bottom of the holder, showing the split collet *A* that grips the end of the spindle, is given in Fig. 19. This collet is tightened by means of the knurled sleeve *B*. In using this holder, the operator rubs it over the diamond-grooved cast-iron lap, rotating it slightly at each stroke in order to wear it evenly. A special gage is used to test the truth of the bottom of the holder from time to time in order to be sure that it is in good shape. Two laps are used, one to take off most of the metal needed and the other to give the final finish. So accurate is the lapping that the ends of the spindle and the anvil may be wrung together as shown in Fig. 20.

Barrels, or thimbles, are drilled, rough-turned and knurled from the bar in a turret lathe, then they are carefully reamed out with an adjustable reamer, as shown in Fig 21. The next step is to place the barrel

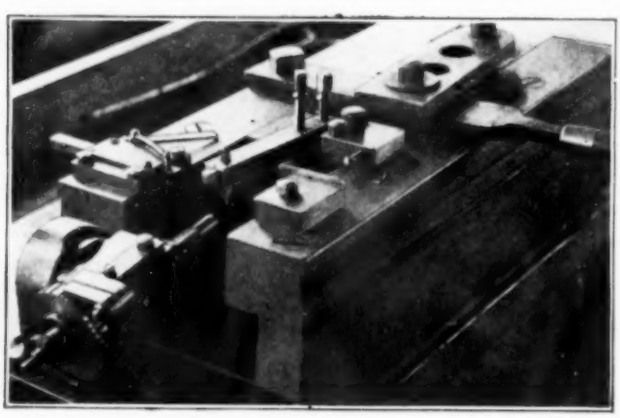


FIG. 25. GRADUATING THE BEVEL ON A BARREL

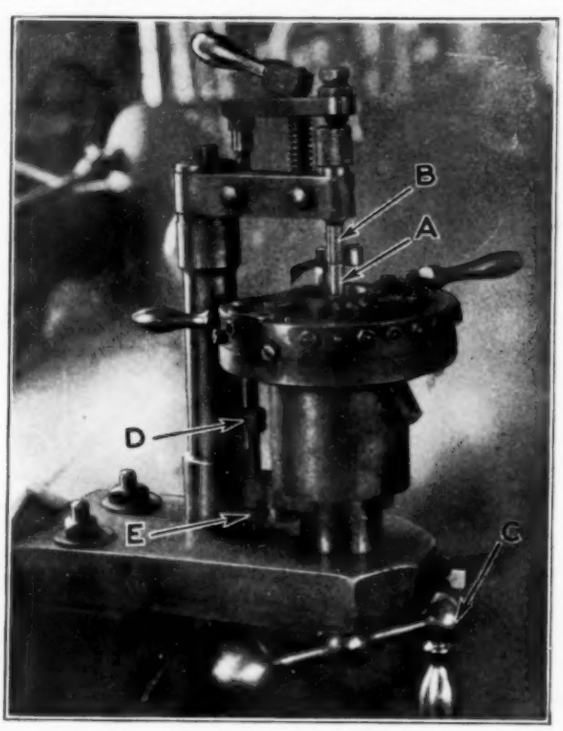


FIG. 26. CUTTING PARALLEL LINES IN A SLEEVE

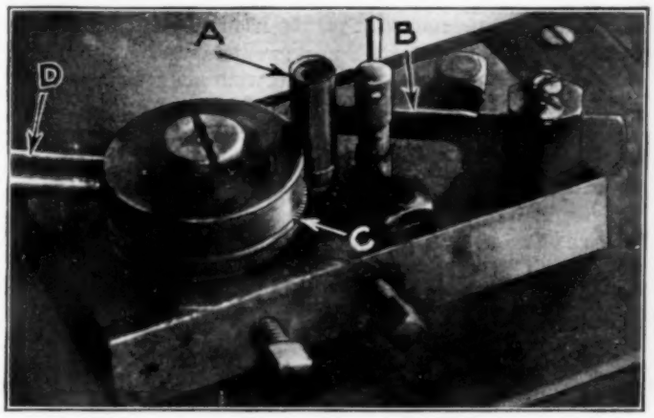


FIG. 27. ROLLING IN FIGURE ON SLEEVES FOR "TEN-THOUSANDTHS" MICROMETERS

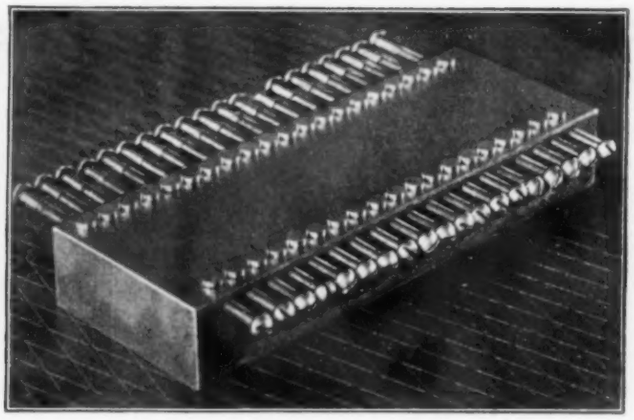


FIG. 28. ANVIL GRINDING AND LAPPING JIG

on a mandrel and finish turn, as shown in Fig. 22. Following this, it is put on a plug mandrel, and the bevel turned as shown in Fig. 23. Next the numbers are stamped in, all at once, in the device illustrated in Fig. 24. In this machine the stamps are arranged radially and are forced inward by means of a cam ring operated by means of the hand lever shown.

The graduations on the end bevel, are cut on the machine, Fig. 25. The indexing is done with the left hand as the operator works the slide lever with his right.

Machining the Sleeves

Sleeves are drilled and rough turned from the bar, and are then reamed in the same way as the barrels. They are then placed on a mandrel and finish turned.

The lines running lengthwise on the sleeves are cut on the machine shown in Fig. 26. One line is cut for micrometers reading in thousandths, and eleven lines for those reading to ten-thousandths of an inch. The single line is cut the full length, but the others, stop far enough from one end to allow for numbering. In the machine, the sleeve is placed over a vertical mandrel at *A* and held in place by means of the eccentric operated hold-down *B*. The carrier for this hold-down may be swung out of the way when desired, by simply releasing the eccentric and pushing the carrier to one side. The tools for cutting the lines are fed into the cutting position by turning the outer cam ring. The whole cutter head is then fed up by turning the handle *C*. Stops at *D* and *E* limit the travel. At the end of the cut the cutters are released by reversing the cam ring, after which the cutter head may be run down and the work removed.

Figures for numbering the lines on the sleeves for the ten-thousandth micrometers are rolled in as shown in Fig. 27. The sleeve is placed over a pin or mandrel at *A* and set in correct position by means of the stop gage *B* which rests in one of the cut lines. The numbers are then rolled in by pulling on lever *D*. Cross lines and the numbers running lengthwise of the sleeves are etched in.

Anvils

Anvils are turned in a screw machine, hardened and then chucked by means of a break-off stub, and cylinder ground. Next they are placed in the jig shown in Fig. 28, and the ends ground in a surface grinding machine. This same jig is then taken to the lapping block and the ends of the anvils all rough and finish lapped at once.

After all the parts of a micrometer have been assembled, the ends of the anvil and spindle are tested for parallelism with Johansson blocks and the screw is tested every tenth of an inch for accuracy with these standard blocks. Where an error in parallelism of the surfaces of the anvil and spindle ends is detected, a special lapping machine is used to eliminate it.

Putting Punch Into "Help Wanted" Ads

By Frank H. Williams

When competition for employees is keen and when the ordinary "Help Wanted" ads in the daily papers fail to bring the desired response, it behooves the plant to put an added punch into its advertising. It is possible to inject a little "jazz" into the Help Wanted ads just as it is possible to liven up and make more interesting and forceful almost any sort of advertising. And, frequently, when a greater punch has been given to the ordinary mere announcement that so many more machinists, etc., are needed, it is found that a single insertion of such an advertisement gets a lot more results than the repeated insertion of a mere every-day announcement.

How Can Ads Be Livened Up?

But how can this added sales-punch be given to the help ads? How can these ads be livened up and made so much more attractive that they will not only attract a lot of attention but also make workmen want to secure employment with the plant that is doing the advertising?

Well, it's a simple proposition—simply examine the matter from the viewpoint of an advertiser. Pick out the big selling point about the job and play up this point in the advertising.

For instance, a Middle Western factory found itself in dire need of additional help in order to turn out the increased quantities of goods it had contracted to make. But the ordinary "Help Wanted" ads in the local daily papers failed entirely of getting all the results desired. The plant superintendent confessed himself up against a stump. He didn't know what to do and finally told the general manager that he'd have to get some help on the proposition. The general manager, in turn, was unable to offer any suggestions and called in the concern's advertising manager to whom the situation was explained.

"Huh," exclaimed the advertising manager, "there's nothing so very difficult about this proposition. This plant has one of the best sales arguments in the city for

getting more employees. I'll simply play it up in our advertising in local papers; then watch the men come."

Accordingly the advertising manager prepared an ad which appeared shortly in the local newspapers. This ad consisted of a space three columns wide by about ten inches high. The upper two-thinds of the ad was occupied by an outline map of the city showing the location of the plant. And under this map appeared this reading matter:

Playing Up Advantages

"You don't have to 'transfer' on the car lines to get to work at the A. B. Plant.

"Look at the map. Notice that this plant is located just two blocks from the transfer corner where all the street car lines of the city center. You can take the car nearest your home and come to work here without having to wait for a transfer car.

"Furthermore you will be right down town during the day—where you will be able to meet your friends during the noon hour, transact personal business and know what's going on in the city.

"This is the place for live-wire men to work—men who want to save time and expense in getting to and from work and in making trips down town to attend to their business affairs.

"We need 100 machinists. Be one of the lucky 100!

"The A. B. Factory, Main and Superior streets."

The response to this advertisement was immediate and enthusiastic. Many machinists who had been working in plants on the outskirts of the city at considerable distances from their homes jumped at the chance of getting in a place where they didn't have to transfer, and still other men who had quite a little personal business to transact during the course of a week were glad to get in a plant where they could do this during the noon hour without hurry or inconvenience and without making a special trip for it.

Of course there are but few plants so fortunately situated as this particular factory. Mighty few plants, consequently, have such sales arguments as this for securing more employees, but it is generally a fact that a careful investigation of a plant from an advertising view-point will reveal some sales arguments which can be played up to good effect in the plant's help wanted advertising.

For instance, is the plant particularly well lighted? If it is, that fact will appeal powerfully to men who have been working in factories where daylight is a mighty scarce article. Is the plant particularly well equipped in the matter of welfare work? Has it special appliances for helping the employees to enjoy themselves during the noon hour and upon occasions when there are social gatherings at the factory? If so this fact is a good talking point and can be utilized in the plant's advertising for the purpose of gaining new employees.

What are some of the financial advantages of working in the plant? Does the plant offer a bonus to employees? Does it insure employees? Is it on a profit-sharing basis? Do employees have the opportunity of purchasing stock in the concern? All of these points are of exceeding vital interest to every prospective employee. Every single thing the plant does along this line is a talking point for securing more workmen. Then why shouldn't the plant play up these things in its help wanted advertising and cash in on them to the fullest possible extent?

There is a reason why plants have not yet done any advertising of this sort to any great extent. The plant end of a concern is not concerned with advertising problems—it deals with matters of production and personnel. Perhaps if there was a closer connection between the advertising department and the factory management there would be more of this advertising. Among concerns like department stores where the whole business is frequently viewed by all the executives from a promotion and advertising angle, this form of help-wanted advertising has been in vogue for some time. Numerous instances have occurred in which the big department stores in New York and in other places went after the problem of getting more help in the same way in which they tackled the problem of selling more goods—they played up all possible sales arguments in their help advertising which would be calculated to make more people want to work for the store. And, by doing this, they secured results when the ordinary form of help-wanted advertising fell flat.

Good for Men Already Employed

In addition to getting the desired employees more quickly by using this form of advertising, such advertising also should have a distinctly good effect upon the men already working in a plant. No man is averse to hearing a recital of the many reasons why his factory is a mighty good place in which to work. He may not have summarized all the good points about his job in his own mind, but when he sees these points played up in the plant's advertising he will be apt to say:

"That's so! I hadn't thought of that! By Jove, I'm pretty fortunate, at that, to be working where I am."

Of course when workmen get in that frame of mind about their jobs, the plant's morale receives a decided boost and production soars.

Yes, it might be a good idea for almost any plant to let an advertising man have a whirl at it the next time the plant's ordinary help-wanted advertising fails to pull in the desired way.

Know What You Are Doing and Why You Do It

By A. W. Forbes

It has sometimes been said that a person shows more intelligence before he is 10 years old than ever afterward, the idea being that the most intelligent thing a person can do is to ask, why?

Today one of my employees, who has had several years' experience in toolmaking, placed a lathe tool on a level with the centers of the lathe, when it should have been slightly lower. I asked him why, and he said he always placed a lathe tool opposite the center, but had no suggestion to make as to why it should be placed there.

It was merely a rule which he always followed. Machinists have a great many such rules which they consider it best to follow but the principal difference between the first class machinist and the ordinary kind lies largely in the ability to decide when to follow a rule and when to break it.

A way that leads to knowledge, but often to various troubles also, is to break every rule and see what happens. I have often found unexpected results this way. However, it is well to use discretion in this.

Human Relations in Industry

EDITORIAL CORRESPONDENCE

The industrial conference, held at Silver Bay, N. Y., Aug. 27 to 29, brought out many evidences that the business men of the country are alive to the responsibilities of the present industrial situation. Many evinced a broad liberal attitude which will go far in preventing clashes between reactionaries on the one hand and radicals on the other.

THE conference was a rather strenuous affair, its sessions crowding each other with but little time between. It opened with an address by Fred B. Smith, assistant to the president of the H. E. Johns-Manville Co., on "The Industrial World Today," which showed keen observation and careful thought on the part of the speaker. There were a few who considered this as an alarmist view, but those who really know the world situation realize that the so-called optimist who only sees the rosy side, is first cousin to the ostrich who is supposed to bury his head in the sand at the approach of danger.

Mr. Smith pointed out some of the problems which are already here, and showed clearly that all who say everything is all right, are simply banking the fires and merely postponing the explosion. His observation leads him to believe that, while some of us are working in the right direction, we have in reality made comparatively little progress and that the fires of unrest, bitterness and conflict have not materially diminished. The problem must grow increasingly difficult, because it is becoming necessary for the nation to industrialize more and more, as the expansive borders are closed and there are no more great frontiers for those whose nature chafes at the close contact of crowded cities. We must of necessity industrialize more closely.

Dangers of "Getting Even"

Mr. Smith considers that many of our difficulties are directly due to wrong ideals in educational matters, that young men leave college to assume responsible positions with utterly wrong conceptions of their duties and responsibilities to society. He finds many of the capitalistic group bitter and evincing a desire to "get even" for being obliged to increase wages and shorten hours during the stress of the past few years. He also finds many wage earners who believe that further and more serious clashes are inevitable, and who, while knowing the resultant hardships and suffering, are steeling themselves to say "let them come." These, of course, are the extremes of both sides. Only by reconciling these extreme groups and by inaugurating once more the spirit of the Golden Rule, can the clashes of the extremes on each side be prevented.

Among the fundamental propositions which he considers inevitable as a beginning, is the adoption of some form of committee representation, the 8-hr. day and the desire on the part of both sides to discuss all questions through the committee plan. He feels that unless those who own or control capital learn to consider it as a stewardship and to use it with a community instead of a selfish spirit, that the day will come when it will be confiscated by the state.

Mr. Smith then proceeded to point out the dangers of such a contingency, particularly so long as we allow ourselves to be represented by the present kind of legislators. A state of real democracy must prevail coupled with a feeling of brotherhood which cannot be replaced by high wages and short hours. The individuality of the worker must be carefully considered.

George E. Emmons, vice president of the General Electric Co., agreed at a later session that while we had made some progress, business men needed counsel as to the future. Something is radically wrong with the industrial machinery, but we must be careful to keep our feet on the ground in proposing and making changes. The experiences of his company with Works Councils varied; though not perfect, they are undoubtedly an improvement over previous methods of dealing.

The Attitude of the Alien

Allen T. Burns, Director of Americanization Methods of the Carnegie Foundation, gave an excellent talk on this subject. He pointed out that, in order to understand the attitude of the immigrant, it was necessary to study the America of the past, when our ancestors laid the basis of a new country because they were not satisfied with their conditions at home. It is this spirit which has built the United States and all of the other newer countries. Bearing this in mind we must not expect the immigrant of the present day to consider as perfect the things which we have accomplished, any more than our ancestors were content to leave the country as they found it. We must not forget that it takes a certain type of person to be an immigrant, one with self-dependence and the pioneer spirit to be the master of his own destiny. It is this spirit which makes the American worker produce more per dollar of wage than the worker in any other country. It is this which makes co-operation difficult and which also causes the difference between European and American democracy. The former grew from a central power, while here the process is just reversed.

Responsibility and Co-operation

One of the great problems is to permeate our industrialism with a knowledge of the necessity for co-operative work. The alien must be given an opportunity to take part in the problem and normally he lacks the capacity to secure collective action.

Mr. Burns told of some of the splendid work of immigrants of various nationalities, and gave specific instances where the revolutionary spirit was transformed by co-operation and by making them feel a real relation to the work and responsibility for it. In one Finnish center they have established a chain of stores, recreation centers, community gymnasiums and other activities. The one mistake which is too often made in dealing with the alien is to overlook the fact that his independence of spirit makes it necessary for him to be a partner and not a beneficiary in any enterprise.

In closing Mr. Burns pointed out the great harm which has been done by the indiscriminate and unwarranted arrests by the Department of Justice which had shaken the faith of many aliens in our boasted democ-

racy and had tended to greatly increase radicalism instead of preventing it. It is his belief that only by being true to the best of American ideals can we get the best from the alien, who must be woven into warp and woof of the fabric of human life.

Make Every Era Great

This was discussed by Dr. Peter Roberts who thought that the immigrants did not always do their part and that they must make an effort to be part of the country in which they live. Roger W. Straus, assistant to the president of the American Smelting & Refining Co., brought out a number of extremely interesting points. The ideals of a country depend upon the character of its citizens, and this character must be capable of development. We cannot expect character in the alien unless we produce it in our own people. It must not be necessary to look *back* to eras of greatness. Character in citizenship should make every era great.

A session on mutual relations in industry was to have been opened by John Golden, president of the United Textile Workers of America, but for some reason he was unable to be present. L. P. Alford, who was to lead the discussion, first outlined the growth of industry in a very clear and concise manner and the causes which were responsible for the growth of the trade unions as well as what they have accomplished. He pointed out that one of the great weaknesses of their present attitude is that, while insisting on the right to strike and admitting a similar right on the part of the employer, labor does not commit itself as to the rights of the public. He pointed out that the workers were necessarily strategically weaker than the employer which necessitated their acting collectively. He further pointed out the need of dependable labor, persons or committees with whom to negotiate, prevention of invasion of individual rights, and the consideration of public demands for service.

The growth of shop councils is shown by the fact that over 300 establishments are now using them. From the engineering viewpoint civilization rests on industry, and the objects of industry are neither wages nor profits, but the production of goods for the benefit of the human race. He closed by quoting from one of the last utterances of H. L. Gantt, to the effect that "service at a profit, not service alone was the object of industry and business, and that this doctrine of service is not only good economics but is the basis of industrial peace."

E. H. Betts, president of the Earl & Wilson Co., spoke of the necessity of inspiration to meet industrial problems and quoted John Calder to the effect that "there are no pink pills for pale industries." No ready-made plans fit, but they may be used as a guide in evolving plans for ourselves. The use of singing in the factories was found very beneficial, the Industrial Quartet having been largely instrumental in securing the participation of the employees themselves.

Get the Right Kind of Executive

Mr. Betts also warned against the attitude of the reactionaries who were saying that "their time had come" and pointed out, as did Mr. Smith earlier in the conference, that such a state of mind was fraught with danger. A proper spirit must pervade the whole plant. Honest employment managers are necessary and all doors must be wide open. Realizing that much of the difficulty comes from the wrong attitude on the part of executives, he strongly urged that they be carefully watched and that only forward-looking men be chosen for executive positions. He ended by declaring that investments were safest in managements based on the Golden Rule, managements that have the confidence and not the suspicion of the employee.

Where Shop Committee Helped

F. J. Kingsbury, president of the Bridgeport Brass Co., and his employment manager both told how shop committees had helped in their plant. They appreciate the value of the right kind of foreman, the one who can make the men feel that they are working *with* him and not *for* him, securing the best results. Easy communication between the men and the management helped to solve the problems brought about by the armistice and increased the effort to maintain wages. The committeemen who were interviewed by representatives of the National Labor Board testified that the mutuality of the plan of readjustment which was worked out together, was a big advance over any previous experience and they pointed out how co-operation pays both sides. Whenever social service work is undertaken, the men share in both the work and their responsibility.

In the discussion it was brought out by Hugo Diemer and others that it was always better to have plans for shop committees or otherwise come from within instead of being forced in from the outside. The management should know the leaders in the shop and the more the men see and know of those higher up, the better. The average American is sincere and appreciates fellowship. It should be realized that the men want to take part and that all men are more or less alike, the main difference being in the amount of truth which they understand and appreciate.

Absentee Management

Sam A. Lewisohn of the copper interests, spoke of the problems of absentee management and the advantages and disadvantages of the old-fashioned manager who had a dogmatic view of humanity and was set in his ways.

He made a plea for the engineers who are qualified technically to handle large properties, being also educated along the line of human industrial engineering, so as to understand the personnel as well as the engineering problems. Directors who are only interested in the problems. Directors who are only interested in the price of the company's stock, absentee owners and directors, as well as resident managers came in for considerable discussion. It was generally agreed that it was better to utilize organizations as we find them as a basis for improving relations and conditions, and also the advantage of prompt action was made very clear by several specific instances.

The necessity for constant improvement was emphasized by the quotation that "revolution comes only when evolution stops."

Square Dealing Must Prevail

John Leitch, who is too well known to require introduction, gave an inspiring address on the "Constructive Adjustment of Industrial Relations," which was widely discussed. Many instances were given where men who had been extreme radicals became constructive instead of destructive when given responsibility, and everything was made open and above board.

Robert Wolf, also well known in this connection, told of his work with both union and non-union labor and the way in which it responded when convinced that everything was square. "The employer who isn't square can't put it over." He believes that industry to be successful from every point of view must give opportunity for creative ability and individuality. With a constructive outlet provided destructive tendencies disappear.

Management Must Be Energized

John Calder in his talk on "The Foreman" gave as the ideal condition "goods plentiful, men dear." The management of industry must be energized and enlightened, and their constructive ideals must be put into practice by the foremen who have direct contact with the men. Utilize the old foremen wherever possible, and there are very few cases where this cannot be done if the new ideals and new methods are presented to them in the proper way.

Some of the older foremen are jealous of the new day and must be shown. The firm must have definite policies and the foremen must know what they are. The importance of the foremen and the small shop is seen when only 2 per cent of the industrial plants of this country employ over 1,000 men. The average is 14 people to a shop, with an estimate of 400,000 opportunities for making proper or improper contact with the workers.

The Foreman's Real Job

The old attitude of the foreman acting as a buffer should give way to the broader view of industry. Fine character and spirit of the work are important factors, and the whole psychology should be studied and understood. There is no question but that injured pride leads to many shop disturbances, and the desire to get even is equally bad on either side. The foremen should be told the whole truth about the business, as it is impossible to sucessfully fool them for any length of time and this, when discovered, always breeds distrust.

The foreman's real job is in making men which is the best investment capital can make. Men are square when treated in a like manner and will respond to open dealings. The joy of the job should be restored as much as possible.

Round-table conferences followed on the various subjects brought up and the closing session was a talk by Roger W. Babson on the fundamentals of prosperity.

"An Expanding Punch for Aluminum Ware"—Discussion

By J. R. Sheppard

The article published on page 199 of the *American Machinist*, entitled An Expanding Punch for Aluminum Ware, has compelled me to inquire why the piece was not expanded by hydraulic pressure instead of the expensive punch as illustrated.

This is nothing new I am suggesting, but am forced to bring up the question of utilizing hydraulics when it is so obvious that it meets the requirements. It is possible to even expand the shell to its final shape, eliminating closing in of the top by the expensive method of spinning.

The equipment required is a simple hydraulic press, a die in two pieces (preferably split just above the flats); this top piece forming a cap through which a plunger is inserted, intensifying the water within to pressure required to expand metal to shape of die.

The cases to which the above may be applied are many, and pressure may of course be applied direct to inside of vessel to be expanded, or may be intensified therein as suggested.

Piston Clearances for Internal Combustion Engines

By C. Strom

Fitting trunk pistons of internal combustion engines is sometimes a problem to beginners; especially so in repair work. The stumbling block is the clearance—what allowance should be made so that the piston will not seize or fit too loosely for smooth running at full load?

This clearance I have found can only be determined by trial with the engine under full load; the reason being that the distortion from heat, the kind of fuel used, the method of cooling and the quality of the iron varies. The bearing of the piston is affected by these conditions and a piston that fits perfectly when cold may show a very imperfect bearing when warm.

Two Methods of Fitting Pistons

There are two methods by which pistons are fitted. One is to finish the piston to a definite size below the cylinder bore so that no amount of expansion will cause seizing, and let it wear its own bearing. This method has its faults and is the cause of many loose pistons, but it is the least expensive as far as production is concerned.

The other method, which is better, is to consider the piston as a sliding surface and fit it as such. This may be done by power or by hand fitting. When done by power the piston is "run in." The cylinder is usually mounted on a suitable fixture or stand while the piston is reciprocated in the cylinder by some crank motion device while a copious supply of grinding compound or oil is pumped over it.

When pistons are to be fitted by hand, the following method ,which I have employed for eleven years on pistons ranging from 4 to 16 in. in diameter, may be used. The piston is finish turned (not ground) with the wristpin in position, as in the final assembly. This prevents any distortion due to pin assembly. The fit of the piston to the cylinder is made snug but should not be a press fit.

To fit the piston for bearing it is forced its length into the cylinder then removed and all high spots filed down. This process is repeated until it shows a full bearing. This will make the piston out of round from 0.002 in. on a 4-in. diameter to 0.006 in. on a 16-in. diameter piston when cold.

This is the trial clearance. The final clearance is found when the engine is started under load. The load is gradually applied, the piston carefully watched, and at the least groan or pounding it is pulled out and all high spots due to the distortion by heat filed down. This process is repeated until the piston shows a full bearing and does not stick or seize at full load. The piston rings must also be spotted to full bearing at the same time.

Modern Aviation Engines—IV

By K. H. CONDIT
Managing Editor, *American Machinist*

AIRPLANE engines with radially arranged cylinders have been grouped in this installment. They are of two types, with fixed cylinders and rotating crankshaft, and with revolving cylinders and fixed crankshaft. The first type is known as the "fixed radial" or "fixed star," and the other as the "rotary."

The two great advantages of engines with this cylinder arrangement are the extremely light weight and the reduced crankshaft length with the attendant economy of fuselage space occupied. To offset these is the high head resistance which makes successful stream-lining a difficult problem.

The early engines of both types were air-cooled and the rotaries are of necessity so designed. Of the two modern fixed radials shown, however, one is water-cooled and the other air-cooled. The vogue of the rotary engine can easily be explained by the fact that the first Gnomes were not much heavier than the modern motors while at that time the best fixed-cylinder engines of conventional design were probably five times as heavy. With the low powers then in use, this was an important advantage and easily outweighed the somewhat temperamental performances of the first rotary engines. Improvements in the design and construction of vertical and V-type engines eventually evened up the discrepancy in weight and the demand for higher powers practically eliminated the rotary engine from all planes but the smallest scouts.

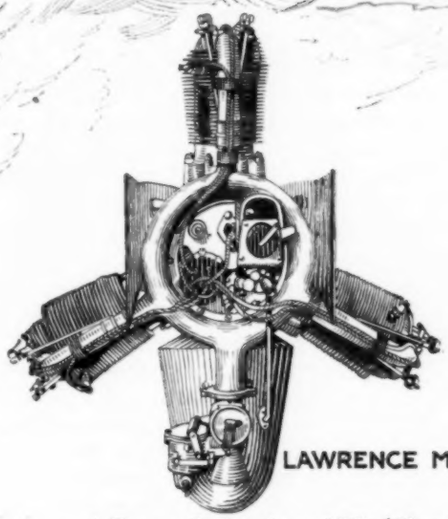
The power limitation did not hamper the development of the fixed radial engines as is shown by the construction in France of Salmson engines of more than 300 hp. and in England of ABC and Metor engines of equal performance. The English motors were not developed in time to be used in the fighting but their experimental performance was so satisfactory that more than a score of new planes had been developed to be equipped with them and were held up awaiting the production which did not materialize in time on account of minor difficulties of design and material.

The Salmson, on the contrary, was largely used in reconnaissance and artillery observation planes both in the French and American air services and was very successful. It went through various stages of development and was built with from seven to fourteen cylinders, although the most satisfactory arrangement was one with nine cylinders mounted in the same plane, as illustrated by the sketch. The crankshaft has but one throw, all the connecting-rod big ends being connected to the same crankpin through a cage which is prevented from improper rotation by gearing. The forged cylinders have corrugated welded steel jackets and the two valves are operated by rockers and push-rods coming from the crank case. The valve springs are of what is sometimes called the cantilever type, the coils being located away from the hot exhaust valves to increase their life. The exhaust gases are collected in an annular chamber surrounding the engine and forming part of the cowl, the outlets being at either side. The duplex carburetor is mounted at the base of the engine, the two intake risers leading into the circular manifold which is part of the crank case and from which the individual intake pipes lead to the intake valves.

The other fixed radial shown is a relatively new American engine which was designed for small sport planes. It is an air-cooled, V-type model with a circular intake manifold. The valve springs are made of ribbon steel wound into a spiral. The cylinders are cast from aluminum and have pressed-in steel liners and cast-bronze valve seats.

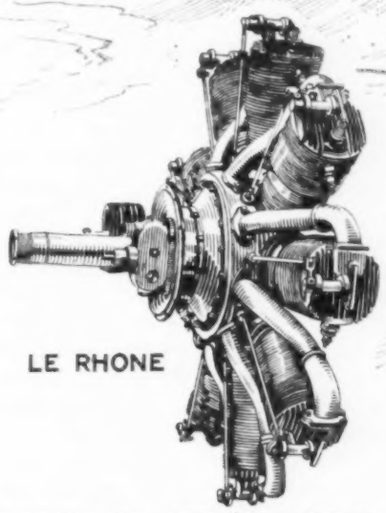
The Le Rhone rotary engine shown is probably the most satisfactory engine of this type developed. An explanation of the operation of this motor without the aid of diagrams is rather difficult but will be attempted. In the first place all existing ideas of the action of the various parts must be thrown overboard to make room for new ones. Here the crankshaft is the fixed part of the engine and provides the support for the whole structure, being attached to the fuselage by two circular plates which are bolted to it. The single crankpin provides a center about which the pistons and connecting-rods swing while the crank case and cylinders are rotating about the main journals. Thus each piston must travel from one end of its stroke in the cylinder to the other while the whole motor is making one revolution. The charge is fired just before the cylinder reaches top dead center, expansion taking place and forcing the piston out of the cylinder as the rotary motion continues. As the inner end of the connecting-rod abuts against the stationary crankpin it cannot back out of the way and the force of the expansion divides into two components, one parallel and the other perpendicular to the center line of the cylinder. The parallel component does no useful work but the perpendicular one pushes the cylinder around and induces the rotary motion which is transmitted to the crank case and propeller through the intervening parts and fastenings.

The carburetor is mounted on the end of the stationary hollow crankshaft which acts as an intake pipe and conveys the explosive mixture to the crank case whence it is drawn out through the individual intake pipes to the inlet valves as required. The exhaust is blown out into the air directly, being collected by the cowl and led off where the heat and flame can do no damage. The cycle of events is quite similar to that employed in the average conventional motor. Ignition is by high tension magneto which is mounted in the fixed back plate. The magneto itself has no distributor, its function being performed by a distributor ring mounted on the rear of the crank case and running in contact with a distributor brush fixed in the back plate. Lubrication is taken care of by pumping oil through leads in the crankshaft to the connecting-rod big ends, from which it is thrown centrifugally to the pistons and out through the exhaust. This system is naturally decidedly wasteful of oil. On account of the presence of gasoline in the crank case, it was considered essential, up to 1918, to use castor oil for lubrication because it would not mix with gasoline, but during that year experiments were made with the standard Liberty aëro oil which showed almost equally good results at a smaller cost. The Rhone cylinders are machined from steel blocks and fitted with cast-iron liners. The aluminum pistons have light steel piston rings. The two valves are operated by a single rocker and push-rod actuated by two five-



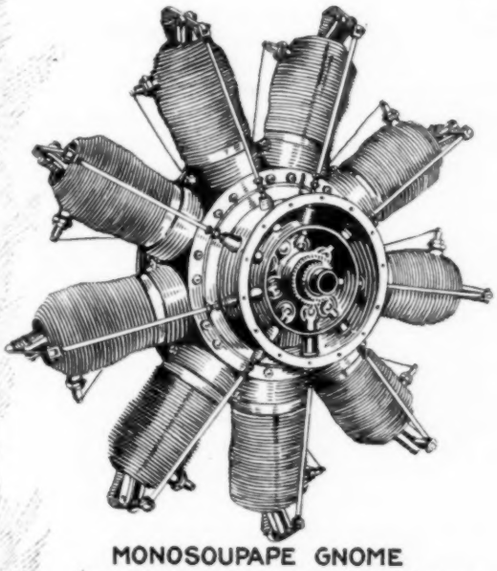
LAWRENCE MODEL L-1

Three cylinders; bore, 4.25 in. (108 mm.); stroke, 5.25 in. (133.4 mm.); rated hp. 60 at 2100 r.p.m.; magneto or battery ignition; dry weight per hp., 2.2 lb.; cooling arrangement, air; arrangement of cylinders, Y at 120 degrees.



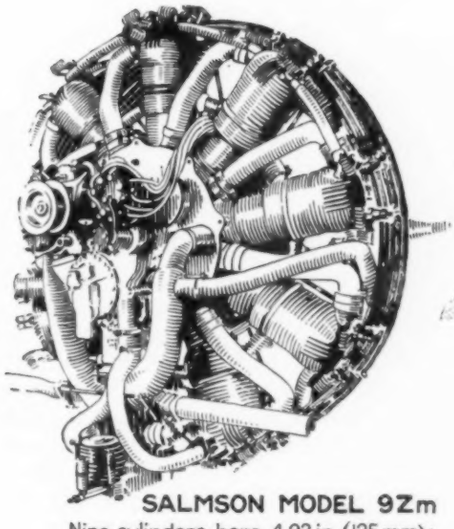
LE RHONE

Nine cylinders; bore, 4.13 in. (105 mm.); stroke, 5.51 in. (140 mm.) compression ratio, 4.8 to 1; rated hp., 80 at 1250 r.p.m.; magneto ignition; dry weight per hp., 3.25 lb.; fuel consumption, 0.6 lb. per b. hp. = hr.



MONOSOUPAPE GNOME

Nine cylinders; bore, 4.33 in. (110 mm.); stroke, 5.9 in. (150 mm.) compression ratio, 4 to 1; rated hp., 100 at 1200 r.p.m.; magneto ignition; dry weight per hp., 2.7 lb.; fuel consumption 0.72 lb. per b. hp. = hr.



SALMSON MODEL 9Zm

Nine cylinders; bore, 4.92 in. (125 mm.); stroke, 6.69 in. (170 mm.); rated hp., 230 at 1550 r.p.m.; magneto ignition; dry weight per hp., 1.75 lb.; fuel consumption, 0.52 lb. per b. hp. = hr.

lobed cams in contact with which are two rollers, one at either end of a rocker connected to the lower end of the push-rod. The valve rocker is pulled down to open the inlet valve and pushed up to open the exhaust valve. The cams are mounted on a cam carriage driven at nine-tenths engine speed by internal gearing.

The remaining engine is the "Monosoupage" or one-valve Gnome, also a nine-cylinder rotary and similar in general operation to the other. The principle difference lies in the substitution of inlet ports around the base of the cylinder for the inlet valve and a consequent change in the cycle of events. No carburetor is used, the fuel being sprayed from a jet into the crank case where it combines with a small amount of air entering through the hollow crankshaft to form a very rich mixture. At the beginning of the inlet stroke the single valve in the cylinder head remains open, thus permitting fresh air to be drawn into the cylinder. A little past mid-stroke the valve closes and a partial vacuum is created which is broken when the top of the piston uncovers the inlet ports and permits the rich mixture to rush into the cylinder to be diluted to an explosive mixture by the pure air already there. The rest of the cycle is quite conventional. Because of the excessive amount of gasoline in the crank case, it is necessary to use castor oil as a lubricant.

One difficulty encountered with this type of engine is the distortion of the cylinder bore due to the difference in temperature between the advancing and trailing sides of the cylinder. In the Gnome a special bronze piston ring with thin, L-shaped cross-section is used to take up the distortion. The L being in the normal position, the tendency on the power and compression strokes is for the gas to get between the ring and the piston and force the former against the cylinder wall, thus improving the seal.

Metric Trouble

By A. D. Lee

For the last year or so, I have been reading so much about the proposed "compulsory use of the metric system," and I have received so many letters and pamphlets from "pros" and "cons," that the thing is beginning to look serious to me. I feel that I ought to do something about it. In the first place, I am considerably disappointed, both at home and at the office, when I receive fat, nice-looking letters and, upon opening them, find them to be merely an argument one way or the other. It has even cost me money, because I have been compelled to buy another waste-basket.

So far, I believe the "pros" have it in volume, and the "cons" in pressure. Not that I read all arguments, or even all of some arguments; but a casual glance through the documents shows that the "cons" understand much better the art of slinging heavy words of ruination, perdition, calamity, vengeance, and so on, whereas the "pros" seem to have a surplus of paper and a more advantageous contract with the printer.

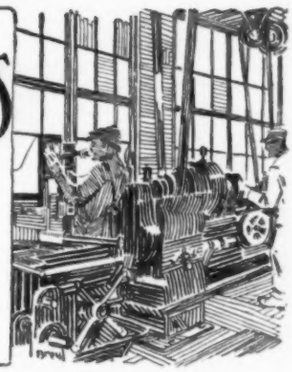
Before I go any further, let me say here that I am rather opposed to making a change; in fact, if people would be satisfied to leave the whole matter to me, I would at once proceed to forget it. However, so many of my good friends seem to be getting a case of nerves that I myself feel a trifle shaky, too, and I have actually asked some people, "What is this law that threatens us with such dire calamities?" They all agreed that they did not know exactly what the law was, but, just the same, it was one ——— of a law and should not be passed. Regardless of the arguments of the "pros" and notwithstanding the arguments of the "cons," I agree with my friends that the law should not be passed, and I would like everybody to understand that, with me, this point is settled. I think this case needs no argument, and I give none. But, human-like, I feel just a wee bit curious as to what that law is regarding the "compulsory introduction of the metric system." How does it compel, and how much does it compel, and what does it compel, and what are the proposed penalties, and what is the proposed machinery for enforcing it? There are a lot of things I want to ask, but I will be satisfied if 50 per cent of my questions are answered.

May I use nothing but metric scales and mikes and gages? May I speak nothing but metric terms? Is it a fine or the workhouse for using common fractions? Will the Federal Commissioner for the Enforcement of the Metric System in the United States have the right of house to house search for two-foot rules and other contraband? Will I still be allowed to buy wallpaper by the roll, or must it be bought by the hectare? Will eggs go by the dozen or by the cubic centimeter? We now buy granulated sugar by the grain; shall it be bought hereafter by the milligram? Will beer come by the litre instead of in the growler? (But no, no, don't answer this, please! I know it will not come at all.) Is it punishable to say there are 3 ft. in a yard or 12 in. in a foot, but permissible to say there are three pansies in my yard and five toes on my foot? Please note that in both cases a prohibited word is used. Sometimes, when I am particularly optimistic, which doesn't happen often nowadays with the High Cost of Living, Bolshevism, Prohibition, and the Spectre of the Metric System hovering over me, I think that the compulsion may be only the compulsion of offering for sale—dry-goods by the meter, groceries by the kilogram, liquids by the liter, real-estate by the hectare. It may even be compulsory to advertise the swing of a lathe in centimeters instead of in inches and, in my optimistic moments, I have the feeling that the only trouble the machine builder will meet will come when he gets a customer who insists on having everything in the metric system. Uncle Sam might be such a customer; in that case, let George take the contract, which, by the way, seems to be quite a common rule now. If any private customer insists on the metric system, tell him to go to ——— say, France, where they have that system at the present. But these moments of optimism are scarce, and when the reaction comes, I ask myself things like this: If, in the privacy of my study, I should whittle out a coffee-mill with my trusty jack-knife, a screw-driver and a 14-in. bastard file, and the diameter of the crankshaft should happen to be exactly ½ in., would I get two years in the pen? If my boss should give me some screws to turn up with a 3 mm. thread, and on inspection he found that the pitch was ¼ in., would I be fired—also jailed?

These, and a hundred other questions, are very important to me—much more important than the fact that the manufacturers of the United States would lose hundreds of millions—or is it billions?—of dollars, because I don't happen to have that much money anyhow. Therefore, Mr. Editor, won't you please be kind enough to publish in heavy print exactly what that dreaded law proposes to do to us?

MODERN PRODUCTION METHODS

By
W P. Basset
of
Miller, Franklin, Basset & Co



I WILL grant that not even a majority of the machine shops have quantity production as does Ford, for instance. Perhaps not a large percentage of the total run quantities of a single part as high as 1,000 at a time, but most shops have lines of product on which they specialize as to general type, although they may run through only two or three or a half dozen on an order.

But the quantity run does not determine whether or not the work can be planned. It only determines how far ahead it can be planned. Planning depends upon the possibility of forecasting approximately how long an operation will take. Of course, if no operation were ever repeated—if no two similar parts were ever made, it is possible that the efforts of planning the work would not be worth while. But that condition, I believe, need not exist. Even a repair shop has enough jobs of similar nature to warrant at least crude planning, even though its efforts be only to keep machines busy and the work progressing without delays. We have successfully planned repair work in several machine shops of industries where the shops were maintained solely to make repairs on the factory equipment. The results in such shops have invariably been to expedite the repairs and to maintain an even force of mechanics, all of whom are reasonably busy most of the time.

IX. Planning in the Ordinary Shop

Mention the planning of production to most machine shop executives—outside of the automotive industry—and they will each spring the good old alibi—"That's great stuff for the fellow who has quantity production, but my business is different." They will then go on to elaborate that they run shops where two orders are hardly ever the same and that their production consequently cannot be planned.

(*Part VIII was published July 29.*)

The truth is that most shops have a much more uniform product than they realize. One may specialize on lathes and drill presses, making several standard types and sizes with slight changes to meet the customer's requirements, and take special work occasionally. Another may make waterwheels principally, each one designed to meet special conditions.

Management is Sometimes Skeptical

The executives of one large shop which turns out a variety of heavy and fairly complex assemblies, were unanimously skeptical of our ability to plan the work. They admitted that, if their production could be planned, the output could be increased, costs lowered and much of the money tied up in goods in process, released. But they pointed to the special machines which they made, seldom more than six of a kind to an order. And they also pointed out that nearly every customer demanded slight changes from normal. They said with assurance that they made 30,000 parts. The seeming complexity of their product made them doubtful, but they were in so much trouble from broken promises and slow production that they decided to see if planning could do anything for them.

Now the first thing to do, as I have shown in a previous article, is to find out exactly what the shop *does* make. An analysis of 10 years' output showed that this concern had made five widely different machines. Counting the variations in slight or great degree from the standard, we found that several hundred types had been made. Many of these variations, however, consisted only in slight dimensional variations in a part or two—many of them unnecessary. Instead of 30,000 parts, we found that but a trifle more than 15,000 had ever been made; more than 5,000 had not been made in 5 years and less than 6,000 could not be called at all usual—much less standard.

A still further analysis showed that when two machines of the same kind, but perhaps of a different size, were made, it was unusual to use any of the same parts on both machines. This deviation was often most slight, yet it precluded manufacturing in even small lots of stock. Variations from standard are not only tremendously expensive, but usually are wholly unnecessary. The customer who wants a whim gratified may think that a difference in dimension is essential. His particular desires at the time seem of surpassing importance to him and to the manufacturer who is after his order. But five years later when the sales urge is forgotten, and the variations from standard can be seen in perspective, most of them are ridiculously trivial. It is then easy to see that the standard machine would nine times in ten, have served the purpose.

The whims of the customer are not alone to blame for this condition—a thoughtless engineer will often design a different part for each size of a machine of the same type where a single part, perhaps of compromise design, will often serve the purpose.

Designing for Economy

Suppose that, in designing two machines of different capacities, the heavier one demands certain parts to be heavier. To save metal, this part may be redesigned

Made out in the Production Department.

Date: Routing is issued.

ROUTE CARD

Material: e.g. Cast Iron or Brass.

Unit Name: Field Saw

Part or Part. Name: e.g. Double Flange Wheel

Ex. L.

PART

PART

New No. ____ Dwg. ____

Old No. ____ Dwg. ____

New No. ____ Dwg. ____

Old No. ____ Dwg. ____

SPECIAL TOOLS JIGS OR FIXTURES	No.	OPERATION NAME	SHOP	MACHINE NO. Preferred	MACHINE NO. Optional	PIECE Set Up	PIECE Piece	Set Up Time	Time Per Pc.
		Brief description of Operations.		100	110-282	10	.05	.2	.1
Number of Jig or Fixture used to perform operation.	Number of operations. Two spaces left to provide for additional possible operations.	Layout included in operation if at machine by same man. If at bench by different man, make out seperate operation.	Shop in which is to be performed.	Machine best adapted to perform operation.	Other machines on which it is possible to do the work.	Information Originates in Time Keeping Department.	" " " " "	Time estimated to start with but to be taken from performance later on.	To be estimated at first and taken from performance later on.

FIG. 48. THE ROUTE SHEET

for the smaller machine. And yet economy would often result if the heavier part were used for both machines; the economical manufacture more than offsetting the excess material.

So much has been said about standardization that it is not necessary to prove its case in detail. Any one will admit its advantages—for the other fellow. But few can apply the lessons to their own product. The problem is too close—the demands of customers too insistent.

However, it is this that stands between many concerns and economical manufacturing. It prevents planning in many shops which might use it. That is why I have given time to a discussion of so hackneyed a subject. For the first step in planning in a shop, is to study the product and eliminate needless variations of design, so that ultimately more parts of a single design may be put into process.

This settled, the next step is to study the demand to the end that some parts may be manufactured for stock. The more of this that can be done the better, for certain parts in shops of the type under consideration will admittedly always have to be made on sales order. If some parts may safely be made in anticipation of future orders, they can not only be economically produced on a single set-up, but they can be put on machines which would otherwise be idle, thus increasing the machine activity. It is just such points as these that make the difference between skillful management and unskillful. They are generally admitted, but seldom practiced, because most men think they face peculiar conditions. The change in methods will assuredly show up at the year's end in the company's statement. It will show up more markedly in the cost system if a good one is in use.

Now, as with quantity production, the time of starting a job depends upon the time taken for each operation. Time is the essence of planning; accurate knowledge of time is the key. If standardization has been carried out to a reasonable degree, time studies of the various operations on each part are well worth making, even if an operation is performed only a few hundred times a year. Perhaps in the ordinary shop only 50 per cent or so of the operations will be reduced to definite time studies, although I believe it is usually possible, and profitable, to get time on 90 per cent of the operations.

When an absolutely new job comes up, the time may be fairly accurately forecast by reference to the tables which are described farther on in this article.

In analyzing the product, it is essential to analyze the operations to be performed down to their elements. What may be considered at first glance to be an operation is thus found to comprise several less complex ones. In this way times for each elemental operation may be set, often by actual time study, from which times on nearly any series of operations, no matter how new or complex, may be built up synthetically.

We have recently had to set price rates for various operations in this way in an industry where literally no two orders are identical. Yet we have been able to analyze the operations to a point where a piece rate may be fairly set for any conceivable product, no matter

Machine No. 167

Type Colburn Drill

Speed Ranges R.P.M. of Spindle 45-509

Max. H.P. Available 7 H.P.

Method of Gear Change Quick gear shift

Max. safe cut C.I.

" " " Steel

Max. dia. of work handled 18"

" Height of " " 42"

Method of handling work Electric crane

Remarks Feed Range .013-.021-.032 .013-.043-.019 Per Rev of spindle

Speeds 45-63-90-126-182-254 362-509 R.P.M.

17" Spindle Travel.

Boring Mills & Drills

FIG. 49. MACHINE DATA SHEET

how complicated. And about 1,000 elemental times had to be set. With 1,000 elemental operations, a good many million combinations may be set up.

I believe that that shop would indeed be an exception which required more than 2,000 or 3,000 or so such elemental times. It is all a matter of intelligent analysis by a man thoroughly familiar with shop practice and the equipment of the specific shop which is being studied.

The schedule-control graph which was described in Article VII may be used with minor changes. In the first place it is not feasible to attempt to plan the work into the shop so far ahead, nor so accurately, for the runs change more frequently and estimates of the time needed must to a degree take the place of known, accurate standards.

Furthermore, we do not plan the work of the shop to machines. The machine tools of such a shop as we are considering may best be arranged in batteries, keeping similar machines together. The unit lineup is economical only when similar parts go through the same series of operation year in and year out.

DATE Feb 24 1919 TIME 10 A.M. STUDY No. PART 32" Gear Plate

MACHINE NO. R.P.M. OPERATION

MAN A RATE TOOL

MAN B RATE SPEED Cut 35' Ret 65' R.P.M.

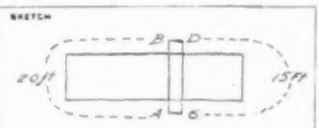
MAN C RATE FEED

MAN D RATE DEPTH

MAN E RATE MATERIAL

MAN F RATE DEPT.

SKETCH



Rep. No.	Performance Name	Stopping Point	Performance Times	Remarks	Std.
1	Start or Stop Machine				2
2	Tool in Clapper Box				30
3	Tool out of Clapper Box				16½
4	Move Heads - Right or Left			4 ft	⅞ Sec per in
5	Move Heads - up or Down			4 ft	2 Sec per in
6	Swing Clapper Box				13
7	Swing Head (10°)				53
8	Adjust Automatic Table Stops				15
9	Movement of Rail - Up or Down			33 ft	2 Sec per in
10	Put on one feed gear				4
11	Take off one feed gear				3½
12	Put on two feed gears				84
13	Take off two feed gears				43
14	Start or Stop Table				12
15	Walk to opposite Controls				5

FIG. 51. TIME STUDY OF ELEMENTARY MOVEMENTS

While the routine of planning must vary to fit the needs of each shop, it seems advisable to describe the methods which we installed in a shop which is, I believe, fairly typical of most shops not engaged in quantity production. This shop employs about 150 men. It has a well developed engineering department and the machine tools are assorted in different sizes, such as lathes, drill presses, together with the other usual tools found in machine shops. The company specializes in conveyor machinery, offering to the trade certain standard models in standard dimensions. However, orders are taken for special machinery, which cause variations from the standard, so that you will see that the shop we are considering conforms with the conditions which I mentioned earlier in the article.

Let us see how this shop handles an order for a coal conveyor, the physical location of which necessitates changes from standard in height, width and pitch of chain, and dimensions of the buckets.

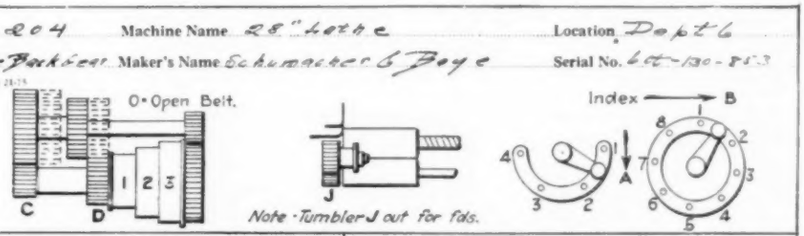
When this order is received it is turned over to the engineering department which prepares drawings of the complete assembly as a whole of the different minor assemblies; and detailed drawings of each part. At the same time the engineering department prepares from these drawings a parts list or bill of material, showing the number of the different parts required in the different assemblies and the dimensions of the rough stock, together with the information as to whether the part in question is to be manufactured or purchased. This bill of material may be similar to the one shown in Article IV, "Engineering the Product." A copy of the bill of material, together with a blueprint of the drawing is then turned over to the shop superintendent.

The next step is to deter-

Machine No. R04 Machine Name 28" Lathe Location Dept 6

Type Double Back Gear Maker's Name Schumacher & Boye Serial No. 6C-130-B-3

Form No. 186—Magee 21-15



Speeds in Feet per Minute

Gear Pos.	Belt Pos.	R.P.M.	Diameters 4"	6"	8"	10"	12"	16"	20"	24"	28"
O	1	164	171	252							
O	2	124	130	194	259						
O	3	88	92	138	184	236					
C	1	14	14	22	29	36	43	58	73	88	102
C	2	10	10	15	20	26	31	41	52	62	73
C	3	8	8	12	16	20	25	33	41	50	58
D	1	40	41	62	83	104	125	167	209	251	
D	2	30	31	47	62	78	94	125	157	188	219
D	3	22	23	34	46	57	69	92	115	138	161

Feeds in Inches

	A 1	A 2	A 3	A 4
B 1	.200	.100	.052	.025
" 2	.177	.088	.044	.022
" 3	.160	.080	.040	.020
" 4	.145	.072	.036	.018
" 5	.139	.069	.034	.017
" 6	.133	.066	.033	.016
" 7	.122	.061	.030	.015
" 8	.114	.057	.028	.014

Longitudinal and cross feeds are same.

FIG. 50. SPEED AND FEED DATA

mine how to make the different parts and through what machine tools they shall pass. Whether you operate a job shop, or the repetitive operation shop, someone must, in the beginning, decide just what operations are to be performed upon the piece. So you see, as pointed out earlier in the article, your problem is fundamentally no different from the repetitive operation shop.

So, on a route sheet for each part, the different operations are listed together with the machine tool which is best adapted to do the work in question. A route sheet was described in Article VI. One especially designed for this shop is shown in Fig. 48. So far we have developed the same information as we did for the

FORM 167 1 2 3 4 5 6 7 8 9 10 11 12 13

DETAILED OPERATION CARD

Dept. No. _____ Mch. No. _____ Order No. _____

Dr. No. _____ Symb. and Patt. No. _____

Operation _____ No. _____

Scheduled to start _____ Qty. on this ord. _____ Qty. on this lot _____

Piece Name _____

No. pcs. Def. _____ No. pcs. Fin. _____

SEQUENCE OF OPERATIONS	SPEED			FEED			CUT IN INCHES	LIMIT	
	P. P. M.	BELT	GEARS					HOURS	10THS

Total time limit _____

Started _____ Finished _____

When Completed return this Card to Planning Department

FIG. 52. DETAILED OPERATION CARD

following operations have to be performed in some cases, i.e., the tool must be placed in the clapper box; the head of the planer raised up or down; the power turned on the machine; the power turned off; the stop motion adjusted, etc. A time study form on which the standard times for each of these motions have been recorded is shown as Fig. 51.

The figures in the colum headed "Std" are the standard times in seconds. Item 4 shows that 4 sec. are allowed for adjustment plus 0.4 sec. per inch of movement. The same method is used for showing the standards for items 5 and 9.

Now for each operation on a part we are able to set

Form No. 176—Magee 20-1683

TOOL CARD

Dr. No. ..... *Patt. No.* ..... *Symbol No.* .....

Piece Name .....

Used on .....

Operation .....

Operation No. ..... *Dept. No.* ..... *Mch. No.* .....

	Kept at Machine	To be Delivered from Tool Room
Tools		
Jigs Templates		
Miscellaneous		

FIG. 53. TOOL CARD

Warner Gear Co.'s repetitive work, except that on the route sheet no times are shown. It therefore is necessary to forecast, as accurately as possible, the time that these various operations will take. But first we must know the capacities of every machine in the shop. Therefore on a form similar to Fig. 49 gather the information as to the capacity and method of handling the work. From a study of the machine we also draw up a card silimar to that shown in Fig. 50, which shows the speeds and feeds for the various combinations of gear and belt positions. These two records give us the theoretical operational capacity of the various machines.

However, before we can really set any times we must know how long it takes to set up a machine and we therefore make time studies of the length of time it takes to make certain elementary moves around the machine. On a planing machine, for instance, the a time, simply by picking out the elementary motions that the man will have to make at the machine tool to place the piece in a position to be cut. Knowing, from the forms, Figs. 49 and 50, the speed and feed, we can easily figure out the length of time that the actual cutting of the metal will take, which will be close enough for all practical purposes of planning. This estimated time will actually be close enough to enable us to set a bonus if we desire.

This synthetic time which we have built up from the known elemental times, gives the time for the operation as a whole, which time is placed on the routing sheet, Fig. 48. The same procedure is followed for each operation. Thus, we have developed for the unknown piece coming into our shop, a routing showing the operations, machine tools and times.

We have now determined the time which each opera-

tion *should* take. We will make an effort to see that conditions are such that the workman can do the work in the estimated time.

To that end we give to the workman a detailed operation card for each operation, showing him the speed, the feed and the cut in inches, and also the time limit that we have assigned for each operation. This is shown in Fig. 52.

Also, at the same time that the routing is made out, the superintendent places upon the route sheet the number of the tool which is to be used. A copy of this information is noted upon the tool card, Fig. 53, for the operation in question, which is sent to the toolroom by the planning department when the work is released to the shop.

We now come to the actual planning by means of a schedule-control graph the same in principle as the one shown in Article VII, although in practice it may appear differently for every shop.

The schedule-control graph is made up from the routings, all operations on each part being drawn backwards and producing a series of lines ending at irregular points.

We have made no attempt, at this time, to assign a definite delivery date to our article. Before we do that, there are one or two points that must be considered. For example, if new castings are required, we must plan to get out the patterns and to get the castings from the foundry. The duration of time allowed for this should also be drawn on the schedule control.

You will note here, a slight difference from the procedure described in Article VII. At plant of the Warner Gear Co. the manufacture of castings, say, was not shown on this schedule-control graph for the material used there was coming in in a constant flow from raw stores. Each new job that came into the shop did not require a special pattern and castings.

It is also desirable to be able to speed the work up in case the delivery requirements of the customer are pressing. It can readily be seen that if we can roughly estimate the piece which will take the longest time in the shop, that the drawing for that piece should be given precedence, and it is well to indicate this fact on the schedule control.

So we then have this marked difference between the Warner Gear Co.'s schedule-control graph and the control for this particular shop. The control graph for this shop shows when the drawings, patterns and castings are required. Of course, sufficient time should be left between each one of these dates for the drawing to get to the pattern shop, to allow the pattern to get to the foundry, and to allow the foundry time to deliver the casting to the machine shop.

Assembly Floor the Objective Point

As I have said so often before in these articles, it is not so important that some of the parts land at the assembly floor on a given date, as it is that all of the parts land on the assembly floor at nearly the same date. It is better to have all of the parts for one assembly done on time than to have some parts for three machines done, and certain parts for all three lacking.

We can then, by taking the number of hours that the shop works, ascertain the different dates when any operation should be completed. In other words, we can determine when the drawing should be started to be prepared; the date the pattern should be started to be made; the date delivery should be made to the foundry; and the date the castings should be delivered to the shop. Now that we have prepared the schedule-control graph we next have to see how it serves as a guide in producing the work. Therefore let us see how this is done by the production manager who has under his jurisdiction the making of the conveyor that we are discussing. As he sits at his desk, on a rack behind him hang the various schedule-control graphs for the different machines on which the shop is working. At his desk are a series of files which serve to represent the different machines in the shop. These files are really nothing more nor less than the production board in the booth, which was described in Article VIII with changes to meet the changed conditions.

Here we have four pockets for each machine. The first pocket is for work that is to be run; that is work scheduled but not yet released into the machine shop. The second is for work which is in the department. The third is for work at the machine. The fourth is for jobs which have been released to the booth in the shop.

The Production Board

Note here the difference between the use of the Warner Gear production board in the shop and the production board in this shop in regards to the scheduling of the work in the department and the work in the machine pockets. The tickets in these three pockets have not yet been sent into the shop, but are kept in the central planning department. The fourth pocket simply shows the jobs that have been released to the shop. It does not show whether the jobs are running or not, but simply the jobs that can be best assigned to the different machine tools by the foreman.

Let us see how the production department controls one part through the shop by following its records through the various stages.

Service cards, requisitions, in-slips, move orders and routings are prepared in advance, just as they were for the repetitive shop described in Articles VII and VIII. Also in the central control there is a file of requisitions to be issued. The jobs are written up in advance, the requisitions, in-slips, etc., are filed by manufacturing order number and in turn by part number under manufacturing order number. These are withdrawn from this file and placed in the second pocket as the date shown on the schedule-control graph draws near. When the date itself actually arrives, the production manager turns over to the booth man the file of requisitions actually to be issued and draws out the two copies of the requisition from the requisitions to be issued, by file.

The booth man files all of these under the heading of the machine which performs the primary operation. As he sees that his machine is beginning to run out of work, he places the requisition on the move board and draws from the stores the material, landing it at the machine which performs the primary operation. The copy of the requisition is then returned to the booth and from there is returned to the central control. The central control can then move the service cards for that particular piece forward into the work at the machine pocket.

On the service cards, the estimated time of the jobs is noted, and on the edge of the fourth pocket, evenly spaced marks are placed, indicative of two-hour periods. A movable pointer is arranged to indicate any mark, which, shows the number of hours work ahead of a given machine or group of machines in the shop. As

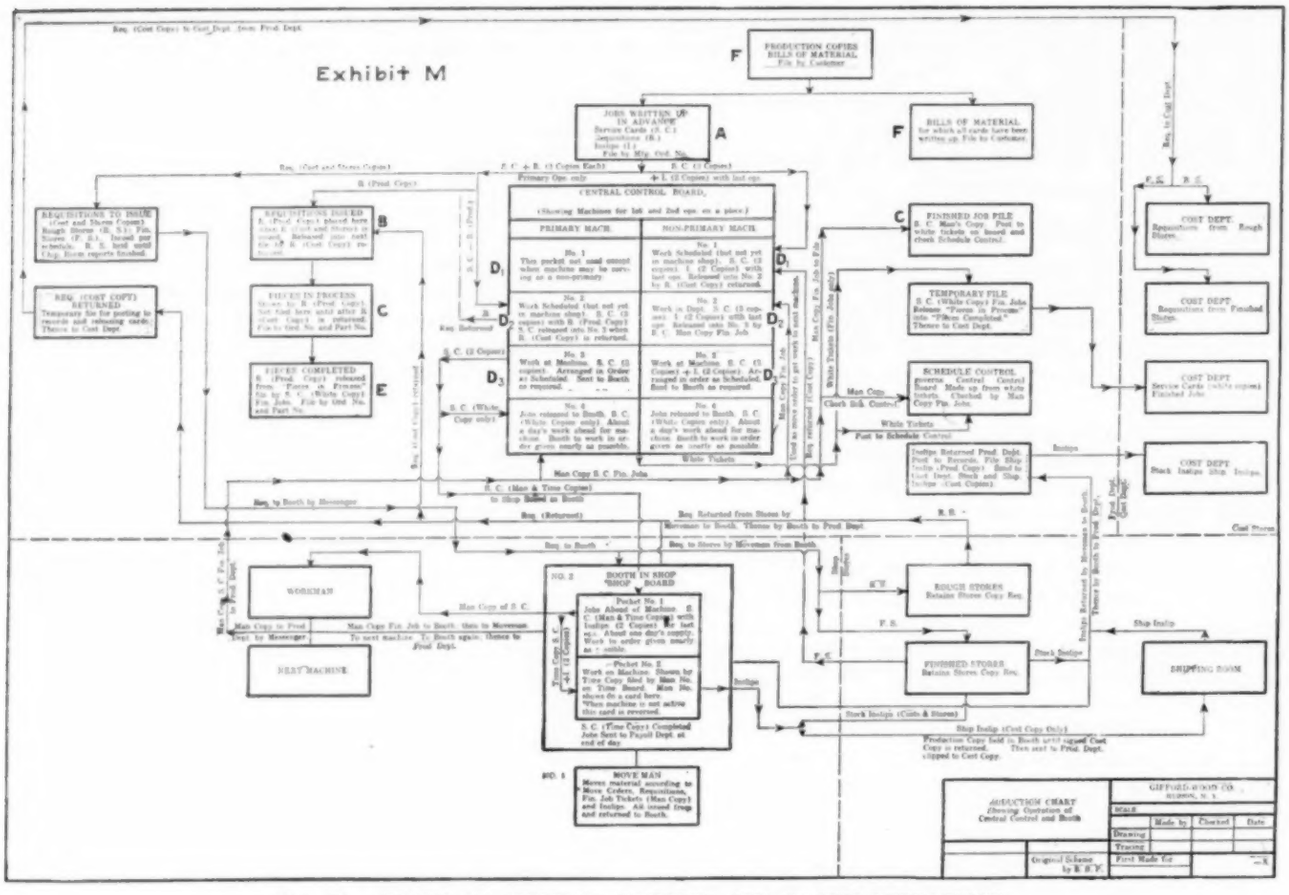


FIG. 54. CHART OF CENTRAL CONTROL AND BOOTH OPERATIONS

work is completed, the pointer is moved back so that by a glance at the board, the production man can ascertain how many hours work are ahead of any machine.

Procedure on Completion of Job

As the jobs are completed in the shop, the service cards are returned to the central control man, who releases to the booth the corresponding ticket in the fourth pocket and moves back his pointer to the number of hours shown as standard on the return job ticket. It is easy to see that by following the pointer carefully and releasing the tickets to the booth as required by the schedule control, that the booth man can at any time see how much work there is ahead of any machine or group of machines.

There is a distinct difference between the production board in the booth in this type of shop from that in the Warner Gear Co., as the booth in this shop has only two pockets, one being used for jobs ahead of the machine, and the other for work on the machine. The reason for this is that no jobs are released to the booth until the jobs are actually at the machine.

A careful study of the chart, Fig. 54, illustrating the various moves of the service cards, in-slips, requisitions, etc., will show that we have provided a means of telling just where each job is in the shop; that is, from the file of requisitions issued, pieces in process and pieces completed, we can tell just the status of any given piece in the assembly.

The main difference between this method of plan-

Accomplishment Control Chart.

Part Name	Pieces Wanted	Part No.	Drawings Finished	Patterns Finished	Materials or Castings Received	Special Tools Received	Date Started in Shop	Labor Estimate. 50 45 40 35 30 25 20 15 10 5
Housing	1	a222	4/15	5/3	5/26		6/15	
Shaft	1	a222	4/15		4/30		5/3	
Bushing	2	a223	4/16	5/9	6/1			

FIG. 55. ACCOMPLISHMENT-CONTROL CHART

ning and that described in Article VII and VIII is that the central control has a much closer relation to the shop and there is not the same attempt made to line up the work so far in advance. After the service cards for the different operations have been returned to the central control, the performance is noted on the schedule control chart card just as in the case of the Warner Gear Co. and the same information as to the standing of our job can be read from it. This same method, it can readily be seen, is adopted whether you are making as we suggested in the beginning, a complete conveyor, a single piece, or any number of pieces. It is particularly useful where work is not repetitive except at extremely long intervals, and where the parts are coming through the shop in small quantities.

We would suggest also that there should be maintained as an executive record, Fig. 55, the accomplishment chart, which shows at a glance what percentage of the labor estimated has been performed upon each piece. This would naturally be gotten at by taking the total number of hours required for each piece and then drawing them in, and then as the work is completed, drawing the line from left to right, indicating the percentage of the estimated time that had been expended upon the piece in question. The value of this record is that it serves at a glance to show the executive how the various orders are coming through the shop.

It will be seen that the shop depends for its information on a system of filing rather than on a system of written records. This again is governed by the fact that the job that is done today is done and may not be done again, so that it would be extremely foolish to set up the elaborate type of records that are essential to the repetitive shop. In this way considerable clerical labor is saved and it brings down the planning and production method to the minimum amount of clerical help.

Because there must be such close contact between the central planning department and the shop, we recommend the use of pneumatic tubes. Another very practical method of sending the service cards back and forth between the central control and the different points desired to be reached in the shop, is the old style hollow rolling-ball. Barring these mechanical conveyors, an efficient messenger service will have to be established, but this should prove no draw-back as any boy or girl at low cost can perform this function, if closely supervised.

It is readily seen that the principles and methods of planning are fundamentally the same, whether the shop be on repetitive production or job orders. In both, the way must be smoothed for the work, definite knowledge must be available as to when, how, and what to make, and finally close contact with the shop must be maintained.

The principal differences between the two kinds of planning lie in the closeness of control and the length of time the work can be planned ahead.

Selling the Sales Force to the Plant Employees

By William Frank

It is quite often the case in large manufacturing institutions that there is mighty little co-operation between plant employees and sales force and mighty little contact between them, too, for that matter. The plant employees are inclined to think that the salesmen are a bunch of white-shirted nuts who are getting by with murder by putting out a big bluff. And the salesmen, on the other hand. are quite apt to think that the plant employees are a bunch of brainless boobs whose work isn't worth what they're paid and who are much beneath the notice of such a superior being as a man who actually makes the sales and therefore keeps the plant running.

Of course where plant workers and salesmen can be made to see how mutually necessary they are to the business and how each of them has problems which the other is unfamiliar with and which he might not be able to handle, then there is certain to be greater co-operation and a consequent increase in morale all along the line.

S. F. Bowser & Co., Inc., of Fort Wayne, Indiana, appreciates the existence of this problem and of the further fact that a satisfactory solution of the problem will everywhere be a good thing for business. And recently this concern took a unique method of solving the problem.

Every year during the summer months the company stages a convention of its salesmen at the home office in Fort Wayne. Usually this convention consists only of "pacemakers"—salesmen who have attained a certain standing by reason of selling the quota fixed for their territory. But this year it was determined to bring all the salesmen into the home office, ordinary salesmen as well as pacemakers, and this determination brought to the home office several hundred salesmen from all parts of the country.

It was felt by officials of the company that the presence of the salesmen at the home office offered a splendid opportunity for creating a better feeling of friendliness and co-operation between factory employees and the sales force so the following plan for doing this was adopted:

Each salesman was given the names of three plant employees, the departments where these workers were to be found, the nature of the work done by each of the employees and some further data. Then the salesmen were given badges which were appropriately inscribed for the wearing of workers during the convention, and were sent out into the factory to look up the workers and to pin the badges on them. Of course, as this was part of the salesmen's jobs at the convention, all of them did as directed. In so doing the salesmen came into personal contact with the factory workers, and upon talking to them, found that they were regular human beings and worth while cultivating. Also the salesmen discovered that the factory workers were doing things the salesmen couldn't do and the workers found that the salesmen were working just as hard as they themselves although in a different way.

All of this had a splendid effect on the force of factory workers and gave a distinct boost to the morale of the plant. It made the workers more enthusiastic boosters for the plant and made them take a more lively interest in the convention and in the salesmen. All the way through it was a very successful stunt.

Isn't there a hint in this for other concerns who find that there is a distinct antagonism between the sales and factory branches?

Isn't it always well worth while to create the best possible feeling of understanding and friendliness between all factors in the enterprise?

Machine Design Again

By ENTROPY

No, this is not an article on sizes of shafts and pulley arms. It is an attempt to analyze the fundamental reasons why some machines are too well built and others not built well enough.

WHEN a man buys a machine, whether it be a power sewing machine, an engine lathe or a tractor, it is usually for the very definite purpose of enabling him to make a profit from the output of the machine. There is no sentiment about it. He may say that he has always bought of So-and-So and prefers to keep on trading there, but what he means is that he has learned by experience that machinery which they build can be depended on to do his work. It may be more highly polished than is necesasry, but he has come to associate that degree of polish with an efficient machine. He looks on the finish just as he does the nameplate, as evidence of authenticity. He will not change merely for a lower price, even though he may concede that some of the frills for which he is paying might well be omitted.

Then, too, his quest for machinery is influenced by the permanence of the market for his own goods. It may apparently be very stable, sufficiently so as to justify the purchase of much special or single-purpose machinery, and yet he may have in mind certain changes which he would like to make which would throw out all such machines. He may not make these changes until he has taken all the possible profit from his present style and kind of product, but he does not wish to take a chance that he will not soon make the change. If he could so design his product that he could start with it five years ahead of the times and keep it on the market five years after the times have caught up to it, he could well afford the special machinery. If he does this he is in danger of finding that his five-year-in-advance-of-the times product is ten years off at one side, and at the best if he has sensed the coming market, he has a long hard sales job to educate purchasers up to the point where they can see that he is on the right track. History is too full of instances where one man invents a machine or a method and loses all his money trying to market it, only to see someone else pick it up later and make a fortune out of it.

It costs a great deal of money to design even a very simple machine, make the patterns, build it without jigs or fixtures, and then perfect it so that it will do the work required. It may be that designers have made original drawings in which every movement of a rocker arm had clear play, every effect of inertia was foreseen, and every part was strong enough and no part so inelastic that it interfered with the working of the other parts, but this is so seldom accomplished that such an accident need not be expected. Certain businesses, however, have to have entirely special machinery. Envelope machines, for example, are mostly indigenous to the factory in which they are used. Second-hand ones are broken up rather than sold so that the secrets of their construction shall not leak out even after they have outlived their usefulness. At the other extreme is the business which can go out any afternoon and pick up enough new and second-hand machine tools to equip its shop before night and have the machines backed up to the door the next day. The effect in both cases is the same. The man who has to have all his machinery built to order, changes his product as seldom as possible consistent with the advances his competitors are making, and the man who depends on stock machinery finds the readiness with which he can enlarge or contract his plant a real asset.

To determine just what machine design should be under different conditions, let us see what factors enter into costs of production which are affected by machine design. There is machinery for speeding up production, which may reduce the proportionate overhead charges for rent and the time during which materials must be carried before they are sold. Then there is that which reduces the labor cost for attendance either by lowering the quality of labor required or by speeding up or by making it possible for one man to attend a number of machines instead of one. Then there is the third and possibly most important way by which machine design may make a better product or one which is more dependable as to quality or quantity.

In the first case there may be required nothing more than a re-design of the machinery in use at present, adding to its strength where needed with due respect to the increase in stresses due to greater acceleration of reciprocating parts, or it may be found wise to re-design from the very beginning. Usually the former is more likely because the man who furnishes the capital can more readily see its possibilities, or rather he likes to more nearly play a sure thing.

Under the second head come automatic machines, and machines of the continuous production type, in which the actual machine operation is automatic, and the workman has only to set the work, which may require skill, and remove it, which seldom does. Such machinery is only justifiable when the returns from its use will pay for it in a comparatively short period of time, and that in turn depends on the optimism of the management as to the length of time it can market the product without change, and on the designer, as to how far he can go in designing such machinery and yet keep it flexible enough to be usable for other than its single purpose.

The third head is the one under which the truly capable designer is most apt to shine above the mediocre man. It is in this kind of design that a man can make use of the forces of nature rather than of man, as for example using the force of gravity in place of gibs. Using weights instead of springs, proportioning slides so that wear will be as constant as possible and distort the movement of slides and carriages as little as possible, making the takeup for wear bring the moving part constantly up to the side which is least subject to wear, and in general making the machine like the old "one-hoss shay" in that it will work to its best up to the last minute of its usefulness.

All these methods couple up machine design with finance, with business and with human nature, and make it just as necessary for the designer to become a student of all three, as of strength of materials, dynamics and kinematics.

The Calibration and Dimensional Changes of Precision Gage Blocks

By C. G. PETERS and H. S. BOYD
U. S. Bureau of Standards

With the interference methods described in this article, the planeness and parallelism errors of precision surfaces can be measured and the length of standard gages determined by direct comparison with the standard light waves to an accuracy of a few millionths of an inch. The errors of other gages can be determined by comparison with these calibrated standards with equal precision. Measurements to this degree of refinement are not easily made; careful manipulation and well controlled conditions are required. They are important, however, and must be made when establishing the precision standards for the testing laboratory.

PRECISION gages, which are blocks of metal, usually steel, having two opposite faces plane, parallel, and a specified distance apart, are used in the shop as length standards for checking micrometers and other measuring instruments, and as distance pieces or size blocks for precise mechanical work. The development in recent years of the art of manufacturing these gages has met with remarkable success, and C. E. Johansson, the pioneer in this field, has for some time been making them with errors that seldom amount to 0.00002 in., while in most cases they are not more than 0.00001 in. Extreme accuracy in construction can however be of but little practical value without at least an equally accurate method of testing. It is impossible to measure irregularities of the surface of such gages with any micrometric apparatus, to make comparisons with standard gages by any contact apparatus, or to discover errors in length by comparison with line standards because the errors in such measurements are larger than the errors of construction. The method of testing should be more accurate than the gage, not less accurate—to the sixth decimal place, if, as here, the error of construction is in the fifth. In December, 1917, we undertook to develop an optical method for accomplishing this; and, in a short time, by applying methods which make use of the interference of light waves, we succeeded in solving the problem.

With perfect gages the accuracy of the interference method would be equal to that with which light waves are measured, namely, about three ten-millionths of an inch. In actual practice we are able to measure the surface errors of gages, to determine the length of our standards, and to compare gages with these standards to an accuracy of one to three millionths of an inch. The method thus possesses the desired virtue of being decidedly more accurate than the gages are made.

Commercial Production

Shortly after the optical method of measurement was put in operation the Gage Section of the Bureau of Standards undertook to develop the process of manufacturing precision gages which up to that time had not been successfully made in this country. The effort met with such remarkable success that within a few months gages with errors of 0.00001 in. or less were being produced on a commercial scale.

Following upon the development at the Bureau of Standards, production was undertaken by manufacturing concerns of this country, notably the Pratt & Whitney Co., Hartford, Conn., and the Wilton Tool and Manufacturing Co., Boston, Mass., who were instructed in the process of manufacture and methods of measurements. These concerns are now producing gages of good quality on a commercial scale.

Requirements and Tolerances

Contradictory to much that has been said and written of late regarding gages "good to the millionth" we have not found one gage whose two working surfaces were plane, parallel, and the designated distance apart within one millionth of an inch, even though we have tested more than 30,000 gages. This record which includes products of all the principal manufacturers should not reflect unfavorably upon the quality of their work. It merely shows that a tolerance of one-millionth of an inch is too small. The tolerance or allowable error should naturally be governed by the precision desired in the use of the gage, by the actual necessity for this precision, and by the effort necessary to attain it.

Since the method of measurement as well as most of the uses of a gage require that its end surfaces adhere to a plane surface (or to another gage), this quality of adherence becomes the first requirement of a gage. We find that for satisfactory adherence to plane surfaces, the gage surface must be plane within a hundred-thousandth of an inch. Obviously, no burrs on the edges are permissible because any minute projection will not only hold two surfaces apart but also cause serious damage to the surface when they are rubbed together.

To take full advantage of the accuracy demanded for adherence the second requirement that the two opposite surfaces should be parallel within at least 0.00001 in. is a practical consequence. It is ridiculous to claim as some do that the length of a gage, meaning the distance between the end faces, is correct to a millionth of an inch if the end surfaces are out of plane or out of parallel by more than that amount. Balanced performance demands that the tolerance in the first two requirements should not be more than 0.00001 in., and with reasonable care the manufacturer can keep within that limit.

Permissible Error

The permissible error in the length, however, should, of course, be governed by the use to which the gage is put. If it is to serve as a standard in a testing laboratory or for the production of precision gages, the length should be determined as accurately as possible. Since gages used as standards have appreciable surface errors we may increase their precision by specifying the distances between the end surfaces near the center of each edge. It is by this method of using a relatively small portion of the surfaces that we are able to determine the

length of our standards within one to three-millionths of an inch. For practically all the other uses such high precision is of little value. A tolerance in length of at least 0.00001 in. for gages one inch or less in length and 0.00001 in. per inch for longer ones should be allowed because it is very doubtful if for various reasons this precision is ever made use of in the shop.

The thermal expansion coefficient of steel is about 0.000012, therefore a gage that is 1 in. long at 20 deg. C. will be 0.00006 in. longer at 25 deg.—six times the suggested tolerance. Furthermore, our measurements on the expansion of gage steel show that the coefficient varies from 0.000010 for annealed steel to 0.0000135 for hardened steel; consequently, two 1-in. gages of exactly the same length at 20 deg. C. might differ by 0.000015 in. at 25 deg. In practice the gage is usually held in the hand and this renders the length uncertain to at least a few hundred-thousandths of an inch per inch of length. Furthermore, all of the instruments tested with these gages are insensitive to a hundred-thousandth of an inch; hence, these instruments would not respond to variations of that amount in the gage. This is true of micrometers as well as all other contact measuring devices. Then too, unless the gage is very thoroughly cleaned, a film of grease or a particle of dust may be present on the surface, which will increase the length at least 0.00001 in. Finally there is the wear on the surfaces through use, and changes of one or two hundred-thousandths of an inch through ageing may take place. Considering all these facts, it seems that, from the standpoint of measurement, but little benefit can be gained by having gages whose lengths were originally correct within a few millionths of an inch. From the manufacturers' standpoint, we find only about one-half of the submitted product falls within 0.00001 in. of the nominal length, while most of the other half falls within 0.00002 in. It results that sets of gages with errors within a few millionths of an inch can be furnished only through very careful testing and sorting. and a needless rejection of a large number of good gages.

We may consider the sensation of light produced in our eyes to be due to transverse waves sent out by the luminous body. These waves vary in length, giving rise to different color sensations. The range of the wave lengths visible to the eye is from about 0.000016 in. for blue light to 0.000028 in. for red. If two trains of waves from one point in a source having traversed different paths fall upon a point on the retina of the eye, the resultant vibration determines the brightness. If they are "in step" maximum brightness results; if, however, the troughs of the one arrive with the crests of the other, destructive interference takes place resulting in relative darkness. If the two trains travel different distances so that the difference in path is some whole number of wave lengths, then the waves will reach the eye in phase. If the difference in path is equal to some whole number of wave lengths plus one-half wave length, the waves in the two trains will be out of phase so that destructive interference takes place. The conditions for interference are realized when light from an extended source *S*, Fig. 1, falls on a thin transparent film. Part of the light is reflected from the first surface, *A B C D*, and the remainder is transmitted to the second surface *A B F G* where partial reflection again takes place. Since the wave trains reaching the eye *E* from these two reflections have traveled over different distances, reinforcement or destructive interference can therefore occur. When white light is used and the film is thin, brightly colored bands are seen across the surface. If monochromatic light, that is, light of one color or of very limited spectral extent is employed, alternate light and dark bands or interference fringes extend across the film.

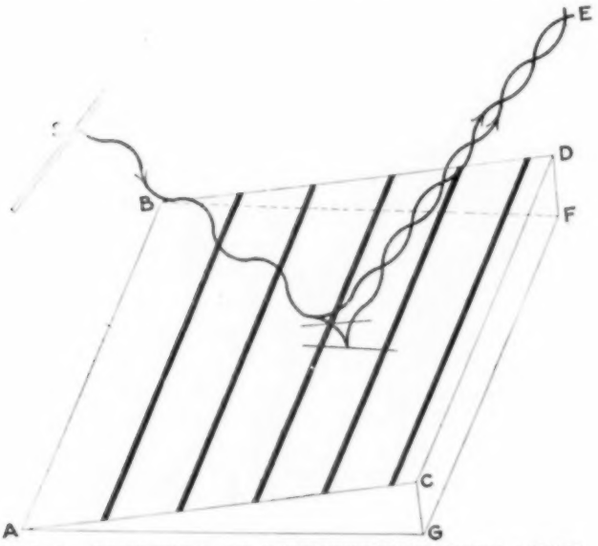


FIG. 1. CONDITION OF INTERFERENCE WITH LIGHT FROM AN EXTENDED SOURCE

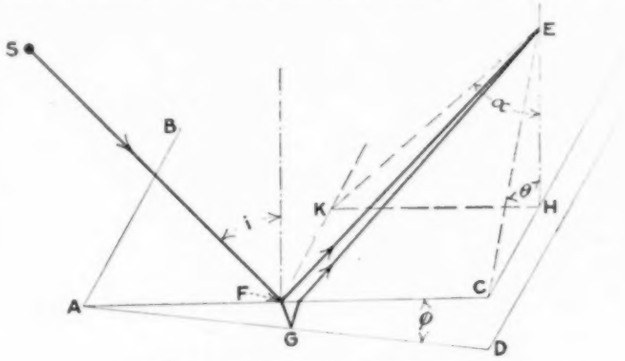


FIG. 2. TEST FOR PLANENESS

Test for Planeness of Surfaces

The test for planeness is made by means of the fringes due to light reflected from the two surfaces of a thin transparent film. Suppose we have two plane surfaces *A C* and *A D*, Fig. 2, which are in contact along the line *A B* and inclined at a slight angle ø. A ray of light from a point in the source *S* reaches the point *F* making an angle of incidence *i* with the normal to the surface *A C*. At *F* this ray is split into two parts, one of which reaches the eye *E* along the path *F E*, while the other, reflected at *G*, travels along the path *F G E*. The effect produced at the eye by these two rays will depend upon the difference in length of these two paths which can be expressed by $N\lambda$ where λ is the wave length of the light and *N* the number of waves. If *N* is any integer the waves will be out of phase, due to half a wave phase change[1] by reflection at the denser medium, and the point *F* will in that case appear dark.

The difference in length of path of these two rays coming from *F* is given by the equation[2]

[1]Only under special cases is this phase change exactly a half wave length. It is seldom necessary, as in the present case, to determine its exact rule.

[2]Michelson, Phil. Mag., 13, 1882.

$$N\lambda = 2\frac{T + P\tan\phi\tan\alpha}{\sqrt{1 + \tan^2\alpha + \tan^2\theta}} \quad (1)$$

where P is the perpendicular distance H H from the eye to the surfaces; T, the distance between the surfaces at H; and α and θ the respective projections of the incidence angle on the planes through E H perpendicular and parallel to A B.

In the case of normal incidence, that is, when the light coming from the source to the surfaces and reflected to the eye passes along the perpendicular to, say, the first surface, the angles α and θ are both zero. In that case tan α and tan θ are zero, giving for equation (1) the simple expression

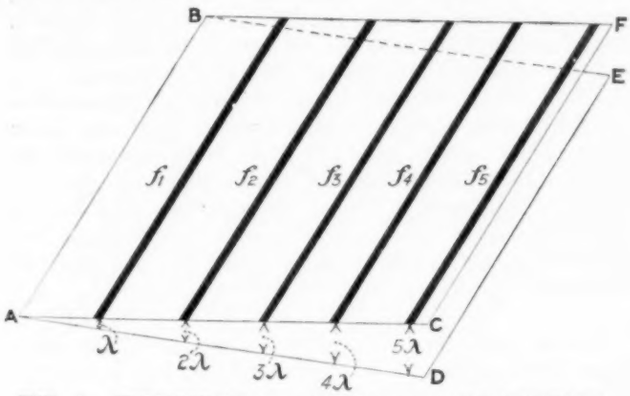


FIG. 3. INTERFERENCE FRINGES, PLANE SURFACE

$$N\lambda = 2T$$

which states that the difference in path of the two interfering trains is simply equal to the double thickness of the wedge (the double distance is used because the light travels down and back through the film). From this equation it is evident that where N is constant, that is along any one fringe, T is also constant; hence, the fringes trace lines of equal separation of the two surfaces.[3] Starting from the line of contact A B of the two plane surfaces, Fig. 3, and moving to a wider part of the wedge, when $2T = \lambda$ interference takes place and the first dark fringe f_1 will be a straight line parallel to A B. When $2T = \frac{1}{2}(3\lambda)$ the wave trains reinforce and a light fringe is produced. Moving to a still thicker part of the wedge where $2T = 2\lambda$ a second dark fringe f_2 will occur, etc. From this, it is evident that if the surfaces are plane the fringes will be straight lines, equally spaced and parallel to the line of intersection of the surfaces. The next dark fringe always occurs on passing to where the double separation increases by λ, hence, the distance between fringes depends on the inclination of the surfaces. If a plane surface be brought in contact with a convex spherical surface, Fig. 4, then at the point of contact $2T$ is equal to zero. Radially from this point the separation of the surfaces increases uniformly in all directions, so the fringes, and hence the lines on which $2T = N\lambda$, are concentric circles around the point of contact C as a center. On any ring the distance of the spherical surface from the plane is equal to the number of the ring counting from the point of contact times $\frac{1}{2}$ (λ). By pressing down at A, the plane surface can be made to roll on the spherical surface shifting the point of contact and with it the center of the ring system in the direction of A, that is toward the point of application of the pressure. With a convex surface the center of the ring system lies at the point of minimum separation.

If one of the surfaces be concave and spherical, Fig. 5, a similar system of concentric circular fringes is produced, but in this case the center of the system lies at the point of maximum separation. Pressing down on A causes the center of the ring system to shift toward B, the direction of increasing separation, away from the point of application of the pressure. Thus a slight pressure on one edge of the plane surface A B serves to indicate whether the curved surface is convex or concave.

With one surface plane and the other irregular the fringes are irregular curves each of which follows the line of equal separation of the surfaces. Whether the irregularity is a projection or depression can be determined by applying a slight pressure to one edge of the upper surface and noting the direction of shift of the fringes.

The amount a curved surface deviates from a true plane can be readily estimated as follows: Draw a straight line C D, Fig. 6 across the center of the true plane surface, parallel to the line of contact H K of the surfaces.

Bring this line tangent to one of the fringes at say the point A. It is evident that this line represents the direction a fringe through A would take if the irregular surface could be converted into a plane tangent to the irregular surface at A. The fractional part of the distance between two fringes by which the fringe E F deviates from the straight line C D gives the fractional part of a half wave length by which the irregular surface deviates along C D from true plane. With

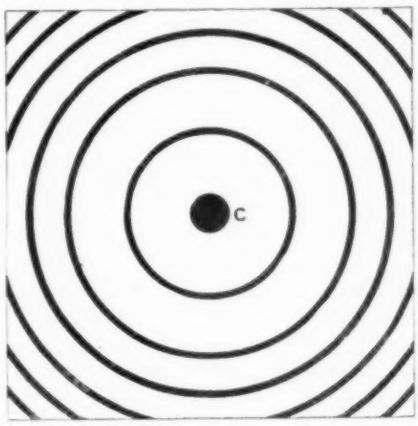


FIG. 4. INTERFERENCE FRINGES, CONVEX SPHERICAL SURFACE

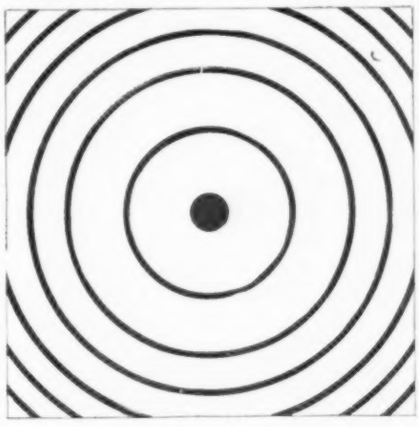


FIG. 5. INTERFERENCE FRINGES, CONCAVE SPHERICAL SURFACE

[3]The fact should be stressed here, however, that, as shown below, the fringe marks the line of constant thickness of film only when the direction of view is perpendicular to the film. Observing on the slant, straight fringes do not indicate that the tested surface is plane.

H K as the line of contact, the point *D* is estimated to be one-fourth wave length above and *C* one-half wave length below the plane surface tangent at *A*.

Testing for Planeness

For testing the planeness of a gage surface, a surface plate, micrometer anvil, or any other polished surface, a test plate is placed in quite close contact with, and slightly inclined to, the surface to be tested. This test plate is of glass one surface of which has been polished accurately true plane and tested against a master true

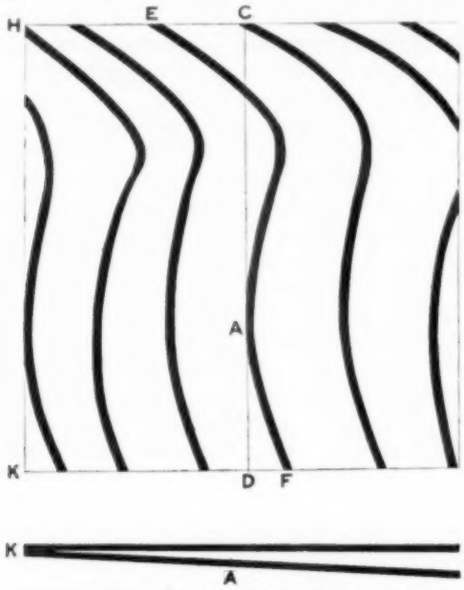


FIG. 6. INTERFERENCE FRINGES, IRREGULAR SURFACE

plane or liquid surface of large extent. The accuracy of the test is of course limited by the irregularities of the test plate surface. It is very difficult to make glass surfaces two or three inches in diameter plane within a 0.000005 in., and to reduce this error requires exceptional skill. For ordinary shop work, however, test plates of sufficient accuracy may be selected from pieces cut from plate glass and tested with a true plane.

For carrying out the test the thin film formed between the plane surface of the test plate and the gage surface is illuminated with monochromatic light. A convenient source of monochromatic light is a bunsen flame in which is inserted a piece of asbestos soaked in a salt solution. A ground glass plate illuminated either by a helium lamp operated on a 5,000-volt alternating-current circuit, or by a mercury vapor lamp is equally good. The wave lengths of the most effective visible radiation from these sources are approximately:

Sodium (yellow) = 0.0000232 in.
Helium (yellow) = 0.0000231 in.
Mercury (green) = 0.0000215 in.

With any of these sources on passing from one interference band to the next, the distance between the surfaces is increased or decreased by $\frac{1}{2}(\lambda)$ or about 0.00001 in., and if still more accurate measurement is desired, one can estimate the deviation of the fringes from a straight line as described. A colored glass screen illuminated by an incandescent lamp or ordinary daylight may be used as a source if high precision is not desired, but the light will not be sufficiently monochromatic to allow assignment of a definite value to the most effective wave length.

With a very true test plate and an illuminating and viewing instrument designed by Pulfrich,[1] we are able to measure slight variations in a surface under test with an accuracy of about 0.000001 in. This instrument, fulfilling very exactly the requirements of normal incidence of the light, permits of the use of formula (2) above.

A close approximation to this condition is obtained with the arrangement shown in Fig. 7. Light from a piece of ground glass *B* which is illuminated by the source *S* is reflected by the thin glass plate *P* set at an angle of 45 deg. down to the interferometer *A G*. The eye *E* is vertically over the center of the gage surface and the interference fringes are viewed through the plate *P*. The only point at which the light that reaches the eye makes normal incidence with the plates (that is where $N\lambda = 2T$) is at the foot of the perpendicular *E D*. At any other point *C* the incidence angle is *i*. Looking out along a fringe through the foot of the perpendicular to a point at the edge of the gage, the light makes an incident angle θ and the formula (1) becomes:

$$N\lambda = 2T \cos \theta$$

Rigidly considered, therefore, a wedge of perfectly plane surfaces would show that fringe, not where the thickness *T* is a constant, but where *T* cos θ is constant and the fringe would curve toward the region of greater separation of the surfaces. Therefore the fringes must have a definite curvature when the surface is viewed at an appreciable slant. This fact may be easily lost

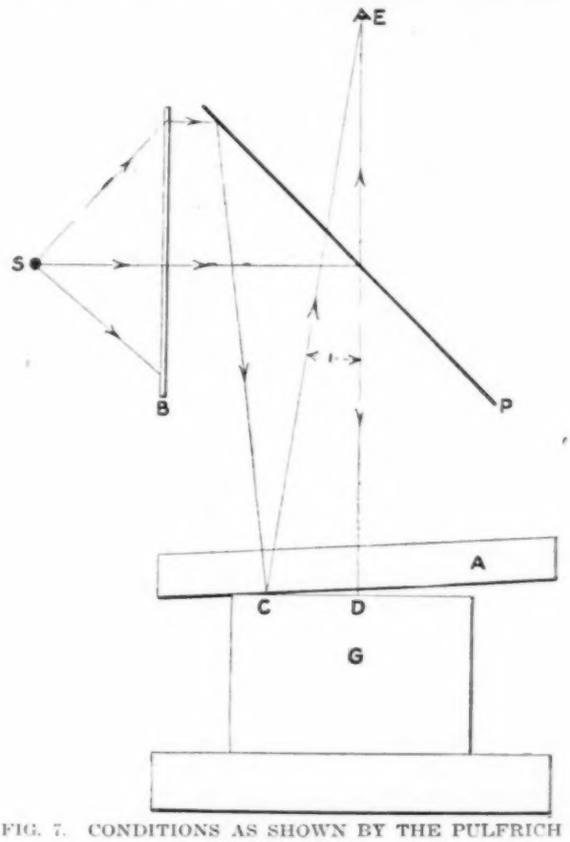


FIG. 7. CONDITIONS AS SHOWN BY THE PULFRICH INSTRUMENT

sight of in both the work-room where true planes are perfected and inspected, and in the laboratory where they are tested. With the eye 14 in. above a pair of true planes 3 in. in diameter and separated by a dis-

[1] Pulfrich, Zeits. f. Instk., Vol. 18, p. 261; 1898.

tance of 20 wave lengths the fringe will deviate from a straight line by about 0.2 the distance between the two adjacent fringes, so that, applying the criterion for perpendicular vision the plane surface would be considered to be out of plane by 0.1 wave length, or 0.000002 in. Measurements of planeness made with this arrangement on surfaces 2 in. in diameter can therefore be depended upon to about two-millionths of an inch.

The customary arrangement for testing planeness is shown in Fig. 8. Here light from the illuminated ground glass screen B falls slantingly on the surfaces of A and G and is reflected to the eye at E making a rather large angle i with the perpendicular $N\,M$. In this case, with the observer looking toward the point M, the rigid formula is

$$N\lambda = 2\,\frac{I + P\tan\phi\tan\alpha}{\sqrt{1+\tan^2\alpha+\tan^2\theta}} = \frac{2T_o}{\sqrt{1+\tan^2\alpha+\tan^2\theta}}$$

T_o representing the separation of the surfaces at M. If the edge of the wedge is perpendicular to the plane of incidence $E\,M\,B$, $\theta = o$, hence

$$N\lambda = \frac{2T_o}{\sqrt{1+\tan^2\alpha}}$$

If, further, $\alpha = i = 45$ deg., $N\lambda = \frac{2T_o}{\sqrt{2}}$ which means that the test is only $\frac{1}{\sqrt{2}} = 0.7$ as sensitive as for perpendicular vision; and, looking at points to one side which introduces an angle θ, it is even less sensitive. If, therefore, an accuracy of 0.000002 in. is desired in the estimation of planeness, the arrangement of Fig. 8 should not be used unless the fringes can be observed from a point very close to the perpendicular from the

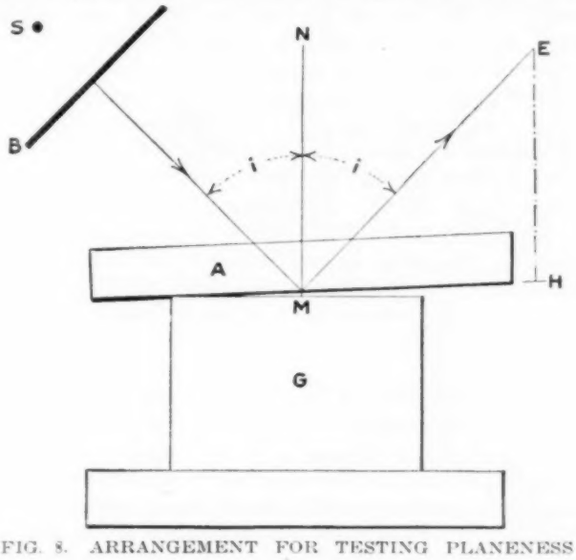


FIG. 8. ARRANGEMENT FOR TESTING PLANENESS

eye to the surface and then the eye should be at least 14 in. above the surface.

When the plane surfaces of two gages, or of a gage and a glass plate, are brought into intimate contact they adhere, necessitating considerable force to separate them. To cause this adherence, the surfaces are first washed with benzol, then with alcohol, and finally wiped with clean cotton to remove all traces of grease and dust. A drop of alcohol the size of a pin head is then placed on the gage surface and allowed to evaporate until nearly all has disappeared. The surface of the plate is then brought in contact with the gage surface, which causes the remaining trace of alcohol to spread out. Any excess of liquid can be forced out by sliding the surfaces on each other. When the two surfaces come into close contact the cohesive force causes them to grip each other and resist a considerable separating force.

A large number of measurements we have made show that when two very plane surfaces are brought into contact in this manner, the separating film is not more than 0.000001 in. thick. What really happens is that the surfaces form intimate contact at the high points,

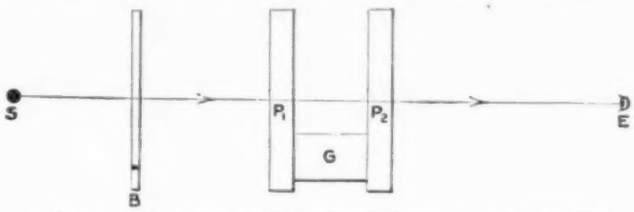


FIG. 9. ARRANGEMENT FOR TESTING PARALLELISM

the liquid filling the fine furrows or scratches left by the finishing laps. Our tests show that two gages with the ordinary lapped finish when brought in contact as described require to separate them, a pull in the direction perpendicular to the surfaces of from 35 to 40 lb. per sq.in. With gages possessing a high optical polish more intimate contact was possible, that is the capillary film was much thinner, and the required separating force ranges between 95 and 100 lb. per sq.in. Considering the extreme thinness of the separating film when good contact exists, the need of exceedingly plane surfaces is apparent. With a nick or burr on the edge or a lump on the surface which hold the two surfaces 0.00001 in. apart, adherence is almost impossible.

Two surfaces will also adhere when covered with a film of grease or with moisture from the hand. The thickness of these films, however, is a rather indefinite quantity, in most cases about 0.000003 in., and while considerable force is required to slide the gages on each other, they can be pulled apart by a force of 5 to 10 lb. For the ordinary uses of gages the existence of the oil or grease film introduces no appreciable error but in making accurate calibration of the gages themselves, it should be eliminated. With gages having slight surface imperfections, the oil film is a decided advantage in holding them together.

Test for Parallelism of Surfaces

The arrangement of the apparatus used to test the parallelism of the surfaces of a standard gage is shown in Fig. 9. Two accurately plane interferometer plates P_1 and P_2 are half silvered on their inner faces. Near one edge of each, a strip of the silver about $\frac{1}{2}$ in. wide is removed. This clear area on P is brought in contact with one end of the gage, G, and that of P_2 with the other end of the gage. This combination of plates and gage constitutes a Fabry and Perot Interferometer. When this interferometer is placed in front of the ground glass screen B illuminated with monochromatic light from the source S, and viewed from E along a line $S\,E$, perpendicular to the silvered surfaces, concentric interference rings known as "Haidinger rings" are seen. When the eye, E, is moved in a direction perpendicular to the line of sight $S\,E$, the system of rings moves across the plates in the same direction, the center of the system always remaining on the per-

pendicular from the eye to the surfaces. If now the interferometer surfaces are parallel to each other, which means that the two gage surfaces which are in contact with them must also be parallel, each ring will retain its original diameter when the eye is moved. If the plates are not parallel the rings expand on moving to points of greater separation, and contract when the eye is moved in the direction of smaller separation. Suppose that when the eye is shifted so that the center of the ring system moves across the plates from one edge to the other the first central ring expands and takes the place originally occupied by the second (a new ring forming within), then the distance between the two interferometer plates has increased by one-half wave length, which for yellow helium light is about 0.000011 in. If the width of the gage is one-fourth that of the silvered space, this would mean a slant of about 0.000003 in between the gage surfaces. Since an expansion of the rings can be estimated to one-fourth of the diameter of the first ring, an error of 0.000001 in. in the parallelism of the gage surfaces can be detected. To realize this precision, however, special care must be taken to have the surfaces of the gage in very close contact with the plates.

Determination of the Lengths of Standards

The lengths of gages which are to be used as standards must first be determined by comparison with some invariable primary standard of length, and redetermined occasionally to insure permanency.

The standard light waves, the most permanent length units known, were chosen as the fundamental standard. The wave lengths of red, yellow and green radiations from cadmium were determined by direct comparison with the standard meter, by Michelson[3] in 1893 and redetermined by Fabry and Benoit[4] in 1907. The values for the wave lengths obtained from these two independent determinations agreed to about one part in fifteen million. The wave lengths of the radiations from other luminous substances have been measured by comparison with these fundamental wave lengths.

For standardizing gages the waves emitted by incandescent neon gas, of lengths ranging from 0.50 to 0.75 microms, were used. These were determined with an accuracy of about one part in four or five million by Meggers,[5] and found to be so accurately reproducible under similar conditions that variations cannot be detected. Therefore, for making measurements with an accuracy of one-millionth of an inch, a comparison with these waves is exactly equivalent to a comparison with the standard meter.

Actual Measurements

The arrangement of the apparatus used to measure gages in wave lengths is shown in Fig. 10. The interferometer formed by the gage and plates of Fig. 9 is placed in front of the slit of a grating or prism spectrograph. Light from the neon lamp N is focussed by the lens L_1 upon a point beyond the interferometer P_1 P_2. Part of the light is transmitted directly through the interferometer, part is reflected by the silvered surface of P_2 to the silvered surface of P_1 where it is again reflected, and then passes on through P_2. The reflected and directly transmitted parts when combined produce a system of interference rings which is focussed by the lens L_2 upon the slit S of the spectrograph. The images of the slit corresponding to the different radiations from neon are separated by the grating B and recorded on the photographic plate C. Since the slit

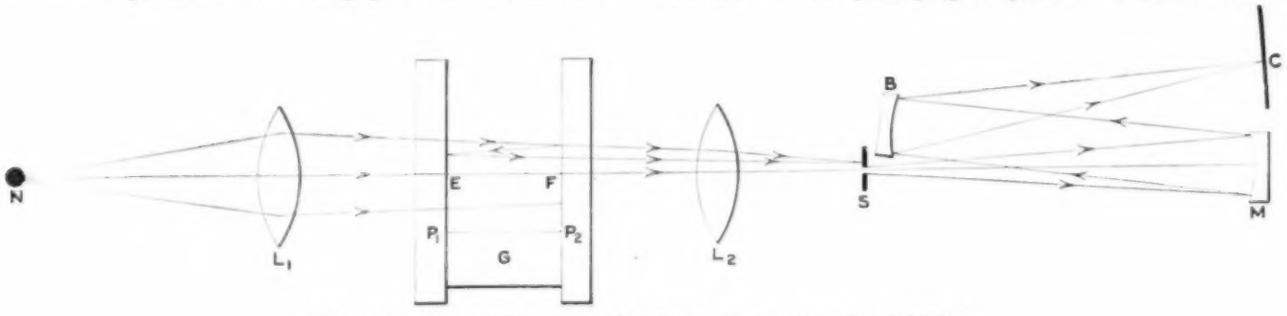


FIG. 10. APPARATUS FOR MEASURING BY WAVE LENGTHS

is illuminated by the ring system, each slit image is crossed by the arcs of its own system of interference rings. By measuring the diameters of these rings the number of wave lengths of any color in the double distance between the plates, which is the path difference of the two interfering trains, is obtained.[6] One-half this number of waves multiplied by the wave length of the light gives the perpendicular distance between the two plates at EF, the center of the ring systems. For the accuracy sought the wave lengths must be corrected for the existing conditions of temperature and pressure of the air.[7] Having the perpendicular distance between the two plates it is necessary to add to this the thickness of the silver films, about 0.000003 in., to obtain the length of the gage, providing of course the gage surfaces are parallel. This is seldom the case, for even after careful selection most of our standards have surface or parallelism errors of about 0.000005 in. A correction for the slope of the plates between EF and the center of each edge of the gage must therefore be applied. These surface irregularities are the greatest sources of error in the determination. Where they are small, different measurements made on the same gage on the same day agree within about 0.000001 in. Of course, to obtain this high accuracy the gage and interferometer are placed in a chamber where the temperature is carefully controlled at 20 deg. C., the temperature at which the length is supposed to be correct.

The length obtained from wave lengths which are expressed in metric units is transformed into inches by using the relation $M/39.37 = 1$ inch.

(To be continued in our next issue)

[3] Michelson, Travaux et Memoires du Bureau International des Poids et Mesures, Vol. 11, 1895.
[4] Fabry and Benoît, Travaux et Memoires, 15, 1913.
[5] Meggers, B. S. Sci. Papers No. 329, 1918.
[6] Meggers, B. S. Sci. Papers No. 251, 1915.
[7] Meggers and Peters, B. S. Sci. Papers, No. 327, 1918.

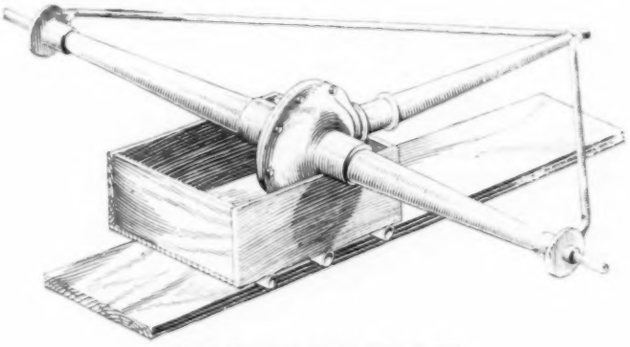
Repair Kink for Ford Owners

By H. W. Johnson

One of the must common repair jobs on a Ford is that of overhauling the rear axle. I have no suggestion to offer regarding the repairs to the axle, but I have worked out a simple trick which makes it much easier to replace the rear-axle assembly under the chassis.

The difficulty most people encounter lies in entering the square shank of the universal joint into the square hole in the transmission. It is quite likely to be a two-man job before it is finished.

Unless your floor is good and smooth, it is best to start out by laying down a board, about 10 in. wide and 2 or 3 ft. long, under the rear of the chassis. Put three or four small pieces of pipe on this board for rollers. Then set a small wooden box, preferably about 8 in. deep, 12 in. wide and 16 in. long, on the rollers.



IMPROVISED ROLLER JACK

The axle assembly, without the wheels, is placed on this box, as shown in the illustration, and pushed under the car by running the box on the rollers. You can now go to the front door of the car, remove the floor board and couple up the drive shaft to the engine easily.

The rollers permit the axle assembly to be pushed back and forth easily, and leaving the wheels off leaves the drive shaft free to turn, so the squares can be matched. After the front end is coupled to the engine, the axle can be jacked up until the spring shackles match.

Here, too, the work is made easier by the absence of the wheels.

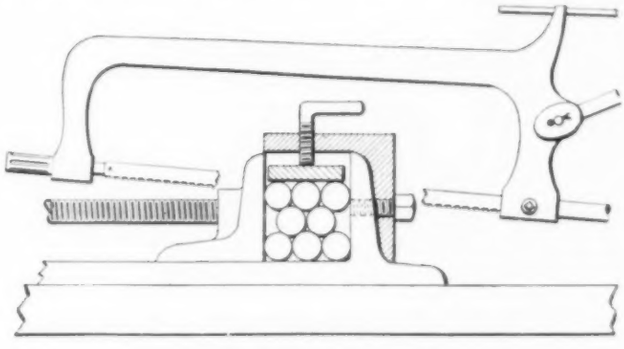
Finally the wheels are put on and the axle jacked high enough to allow the box to be removed. Some garages are equipped with a roller jack device for this work, but for the man who has none, it would be hard to beat the soap box and pipe combination.

A Power Saw Clamp

By E. F. Tuttle, Jr.

Having a number of pieces to cut off of small rod (¼ in. to ½ in. in diameter) we rigged up the power saw as shown in the sketch to do the job.

A piece of 4 x 4 x ½ in. angle iron was cut off the same length as the width of the vise jaws of the machine and two holes were drilled in the angle iron. Two holes were drilled and tapped in the stationary jaw to hold the angle iron. Later the holes in the angle iron were slotted to the edge so it could be removed easily.



THE CLAMP IN USE

In the other leg of the angle iron a ½-in. hole was drilled and tapped through which could be run a screw to bear on the block of soft steel. This piece of steel enabled us to tighten up on a number of rods and thus cut off all at one cut.

Laying Out Angles

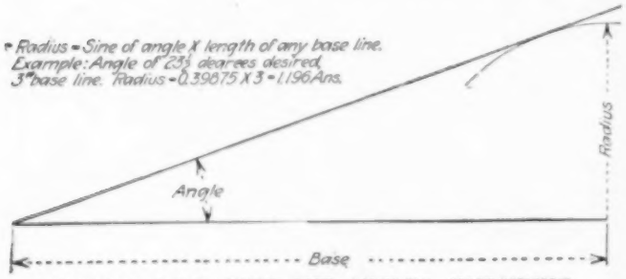
By Chester E. Josselyn

A pattern maker informed me sometime ago he had a large pattern to make that required some angular work which the blueprint specified in degrees.

He said giving the angle to him in this case was almost useless as he could not depend upon plotting it with a protractor with any degree of accuracy and desired to know how to lay out an angle by measurement. I showed him how to lay out an angle by scribing an arc (equal in radius to the sine of the angle wanted, multiplied by the length of the base line in inches)

from one end of the base line and drawing a line tangent to the arc and joining the base line at the other end.

I have since arranged a table of sines which I think


Radius = Sine of angle X length of any base line.
Example: Angle of 23½ degrees desired.
3" base line. Radius = 0.39875 X 3 = 1.196 Ans.
Radius
Angle
Base

METHOD OF LAYING OUT ANGLES, INCLUDING TABLE OF SINES

handy for both designers and mechanics. It includes sines for each one-half degree up to 45 degrees.

For large work a drawing should not only specify the angle but a means for its practical development.

METHOD OF LAYING OUT ANGLES, INCLUDING TABLES OF SINES

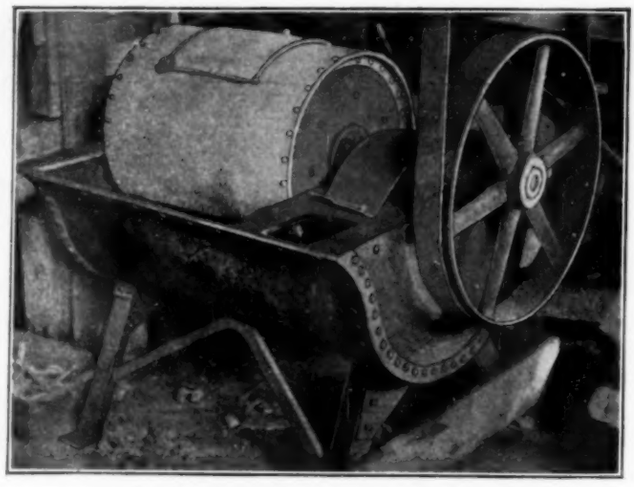
Degrees	Sine	Degrees	Sine	Degrees	Sine
½	0.00873	15½	0.26724	30½	0.50754
1	0.01745	16	0.27564	31	0.51504
1½	0.02618	16½	0.28402	31½	0.52250
2	0.03490	17	0.29237	32	0.52992
2½	0.04362	17½	0.30070	32½	0.53730
3	0.05234	18	0.30902	33	0.54464
3½	0.06105	18½	0.31730	33½	0.55194
4	0.06976	19	0.32557	34	0.55919
4½	0.07846	19½	0.33381	34½	0.56641
5	0.08716	20	0.34202	35	0.57358
5½	0.09585	20½	0.35021	35½	0.58070
6	0.10453	21	0.35837	36	0.58779
6½	0.11520	21½	0.36650	36½	0.59482
7	0.12187	22	0.37461	37	0.60181
7½	0.13053	22½	0.38268	37½	0.60876
8	0.13917	23	0.39073	38	0.61566
8½	0.14781	23½	0.39875	38½	0.62251
9	0.15643	24	0.40674	39	0.62932
9½	0.16505	24½	0.41469	39½	0.63608
10	0.17365	25	0.42262	40	0.64279
10½	0.18224	25½	0.43051	40½	0.64945
11	0.19081	26	0.43837	41	0.65606
11½	0.19937	26½	0.44620	41½	0.66262
12	0.20791	27	0.45399	42	0.66913
12½	0.21644	27½	0.46175	42½	0.67559
13	0.22495	28	0.46947	43	0.68200
13½	0.23345	28½	0.47716	43½	0.68835
14	0.24192	29	0.48481	44	0.69466
14½	0.25038	29½	0.49242	44½	0.70091
15	0.25882	30	0.50000	45	0.70711

A Home-Made Water Tumbling Barrel

BY JOHN VINCENT

Brass castings are frequently tumbled in a barrel with water in order to remove the sand and to give them a brighter, cleaner finish than can be obtained by tumbling them dry. The illustration shows a home-made water tumbling barrel which was built by the Illinois Pattern and Foundry Co., Chicago, Ill., for use in its cleaning room.

The trough was made of scrap from an old oil barrel riveted to angle iron at the joints, and made with a flaring front so that the accumulation of sand and dirt in the bottom could be more readily scraped out. The top edge was reinforced to give it strength to carry the weight of the rotating barrel. The barrel itself was made from an old heavy-weight oil drum reinforced on the ends and fitted with trunnions. The cover plate shown on its side is bolted on and can be quickly removed for filling the barrel with castings. There are a number of holes in the end of the drum which permit the water to enter and circulate through it, carrying out the dirt and sediment. The tank itself is kept about half full of water and is provided with a drain at the bottom so that the water can be drawn off before clearing out the sediment.



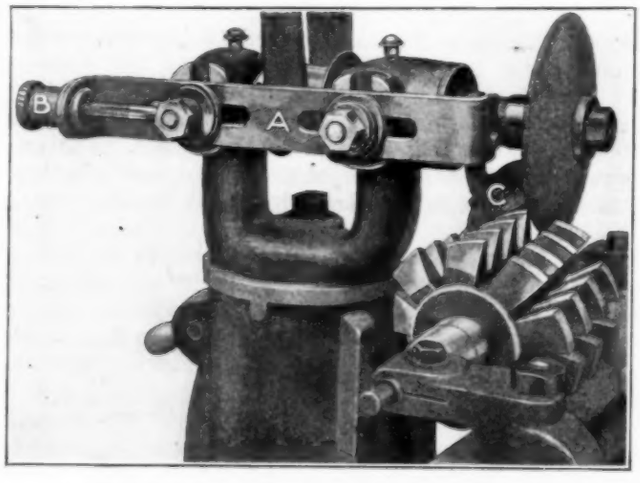
A HOME-MADE WATER TUMBLING BARREL

Grinding Hobs

BY EUGENE E. HENRY

The accompanying illustration shows an arrangement for holding gear-cutting hobs while sharpening them. This method is adapted to use on all spiral hobs regardless of the number of teeth or the amount of twist, as the guide or stop acts directly on the backs of the teeth that are being ground. The device is here shown attached to a No. 1 Le Blonde cutter grinder.

It should be noted that the hob is mounted between low center posts, so as to get it low enough to pass under the wheel, a swing of 3½ in. over the table being used. On the front of the grinder head a ⅜ x 1¼-in. bar *A* is fastened. It is adjustable horizontally, being mounted on the studs with a slight clearance so that it can be moved by turning the thumbnut *B* on the eye-bolt. The end of the bar near the grinder wheel carries the guide *C*, which has a vertical adjustment. The lower edge of *C* is faced with a piece of hardened steel, so that it is not cut by the teeth of the hob being ground. The hob is held by hand against the guide or stop *C*, and the table is moved with long strokes the full length of the hob while light cuts are taken. A 5-in. alundum saucer wheel, No. 38-46 K, is used.



METHOD OF GRINDING GEAR-CUTTING HOBS

SHOP EQUIPMENT NEWS

-Edited by-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Norton "Multipurpose" Grinding Machine

A machine just completed and ready to be delivered by the Norton Co., of Worcester, Mass., is the "Multipurpose" grinding machine, shown in the accompanying illustrations, of which Fig. 1 is a front view and Fig. 2 a back view.

The machine is intended to serve all the purposes of the so-called "universal" machine in grinding parallel and tapered work, cutters, reamers, etc.

This machine is entirely self contained and requires no overhead works. As shown in the illustration, it is arranged for a "single belt constant speed" drive and may be belted direct from the line shaft. There are no other exposed belts, and if arranged for direct motor drive even this one is eliminated.

Capacity of the Machine

The machine will swing work up to 12 in. in diameter and 36 in. long. Both the headstock and wheelhead have swivel bases, graduated in degrees. The work spindle is hollow and will pass a ¾-in. bar. The drive to the headstock is all geared, the power being transmitted from the main drive shaft in the base through splined shafts, the upper one of which also swivels to accommodate itself to angular positions of the head or of the upper table when grinding tapers or bevels.

The gears in the headstock run in oil. By the movement of a lever the rotative speed of the work spindle may be varied from 53 to 320 r.p.m. in six steps. Spindle speeds are entirely independent of table speeds. The center may be either "live" or "dead" as required.

The tail spindle has a quick lever-movement for mounting and demounting work and a screw movement for fine adjustment. The upper table swivels at the center and a triple graduated scale at one end enables a setting to be made in degrees, taper per foot, or percentages.

The table traverse mechanism is similar to that previously used on the Norton machines. There are eight changes of speed ranging from 2 ft. to 11½ ft. per minute. Speeds are changed by means of a four-step cone and back gears on the front of the base.

Spindle-Drive Belt Inclosed

The drive to the wheel spindle is by inclosed belt running through the hollow swiveling head, and by an ingenious arrangement of spring loaded idlers, the head may be turned completely around without interfering with the freedom of its movement.

The wheel spindle is double ended and arranged to carry a 12-in. diameter wheel on either end. An internal grinding fixture attaches to the back end of the wheelhead, which is turned 180 deg. to bring the internal grinding spindle into action, and is driven by belt from a pulley mounted in place of one of the grinding wheels.

The spindle runs in hard bronze bearings with tapered sleeves for taking up wear. The end thrust is borne by a collar.

The Wheel Feed

The wheel feed may be either automatic or by hand. The automatic feed operates at each reversal of the table and may be adjusted to increments of one-quarter thousandth.

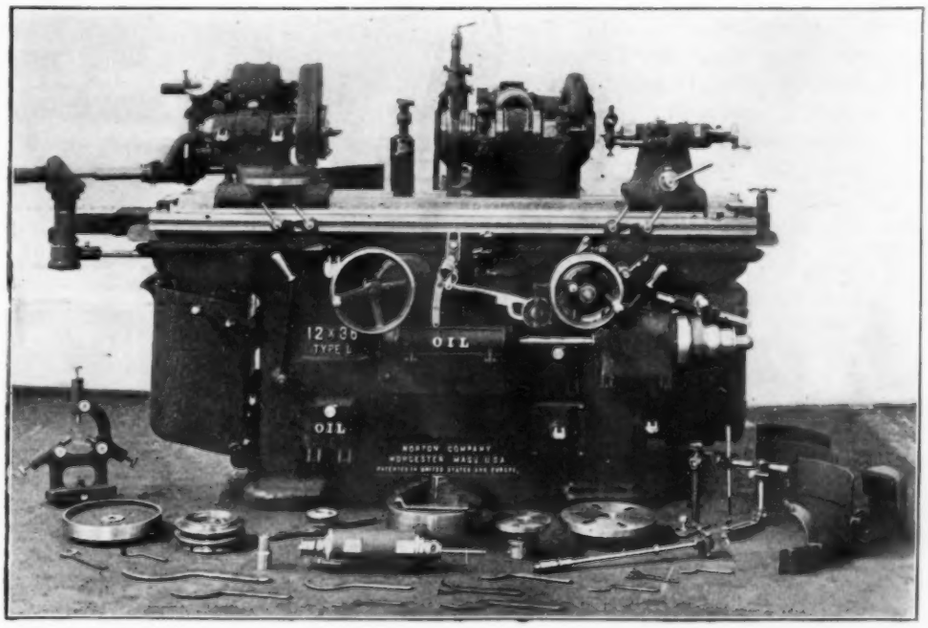


FIG. 1. NORTON "MULTIPURPOSE" GRINDING MACHINE (FRONT)

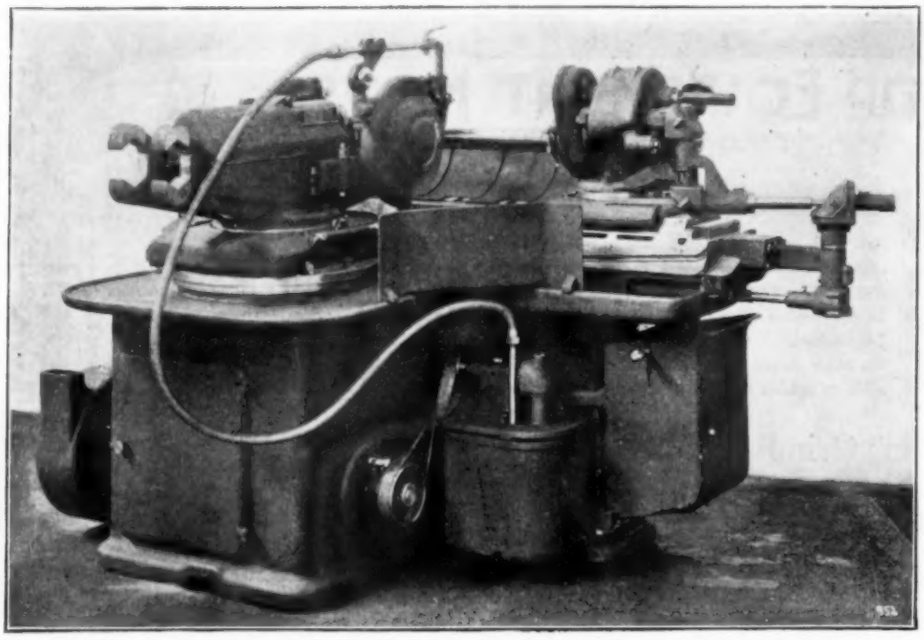


FIG. 2. NORTON "MULTIPURPOSE" GRINDING MACHINE (BACK)

The machine is supplied with a complete set of accessories. Approximate weight of machine with regular equipment is 4,950 lb. Floor space required 11 ft. 8 in. x 5 ft. 5 in.

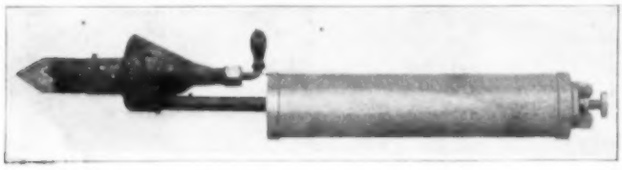
Gardner Improved Abrasive Disks

The Gardner Machine Co., Beloit, Wis., has developed an improved type of abrasive disk for use on disk grinding machines. The illustration shows a disk mounted on the steel disk-wheel of a grinding machine. Among the features of the improved disk are its increased thickness, its corrugated surface, and the bond used in its construction. It has more than twice the thickness of the ordinary glue-bond disk. The corrugated surface is said to tilt the abrasive grains into the best position for cutting. The bond is a special cement which powders away during the grinding operation, presenting new cutting points to the work. It is claimed that the improved disk will last longer, cut faster and cooler than the glue-bond disk, and will materially reduce the maintenance expense of the grinding machine proper.

IMPROVED ABRASIVE DISK

Ever-Hot Soldering Iron

The soldering iron shown in the illustration is made by the Peterson-Plummer Manufacturing Co., and sold through Belfrey & Craighead, Tribune Building, Chicago, Ill.



EVER-HOT GASOLINE SOLDERING IRON

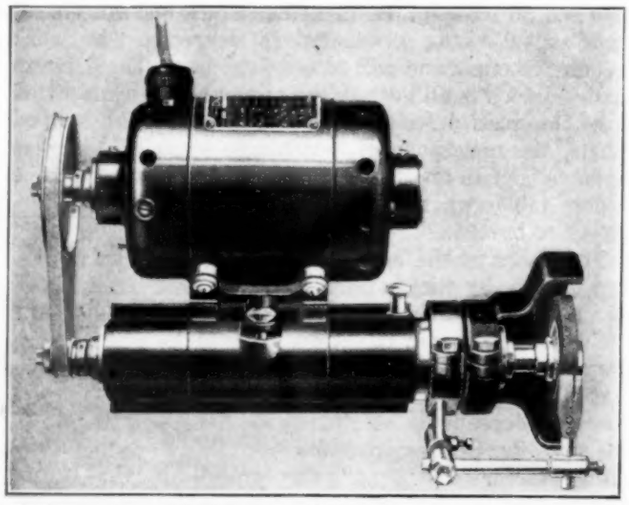
This soldering iron is light in weight and of convenient size to suit the requirements of the user for both light and heavy work. The gasoline reservoir is contained in the handle which is made of seamless brass tubing. The pump unit is placed at the end and is easily removed for refilling.

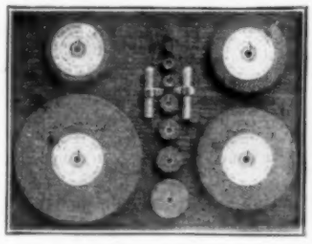
A rust-proof iron pipe connects the handle with the burner and contains cotton wicking to insure a continuous flow of gasoline. The burner is a one-piece brass casting arranged to preheat the gas and its design permits the use of the iron in any position in both extreme cold and high winds.

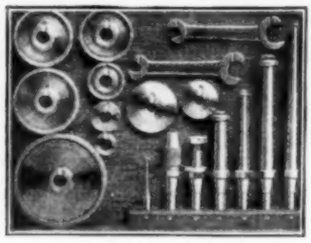
One large and one small point are furnished with the iron.

Dumore No. 3 Multi-Speed Grinding Machine

The Wisconsin Electric Co., Racine, Wis., has added to its line of Dumore grinding machines the No. 3 multi-speed machine shown in the illustration. The device is adapted to both production and toolroom work, and is







DUMORE NO. 3 MULTI-SPEED GRINDING MACHINE AND EQUIPMENT

Specifications: Motor, ¼ hp. Universal, for d.c. and a.c. current. Seven spindle speeds, 3,600 to 50,000 r.p.m. Spindle adjustment, 5½ in. Net weight, without equipment, 25 lb.; with equipment, 35 lb. Shipping weight, 45 lb.

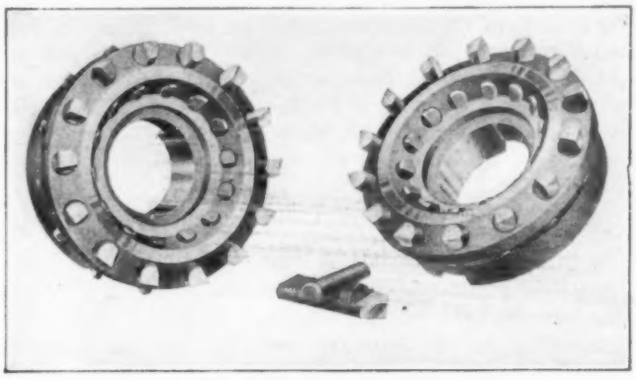
provided with a set of interchangeable spindles and pulleys so that a wide range of spindle speed is obtainable.

The spindle is tool steel and mounted in adjustable, dust-proof ball bearings. Four extension spindles for use on internal work, together with wheel arbors for light and heavy grinding, are furnished with the machine. The armature bearings of the motor are mounted on rubber insulators to eliminate vibration that could be carried to the spindle. The device can be swiveled to any angle necessary in practice. When used for light tool grinding, the toolrest and shield for the wheel can be attached.

Lovejoy Face-Milling Cutter

The cutter shown in the illustration is recommended by its manufacturer, the Lovejoy Tool Co., Inc., Springfield, Vt., for all face milling where the depth of cut does not exceed ⅝ inches.

The teeth of this face-milling cutter are positively



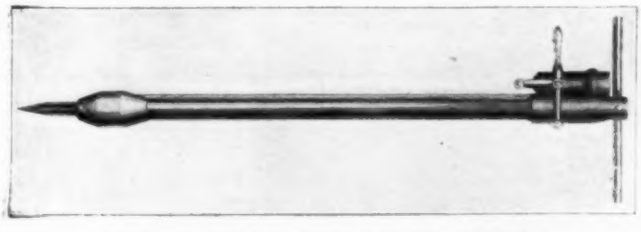
LOVEJOY FACE-MILLING CUTTER

locked by the arrangement shown in the insert between the two views of the cutter. This is said to insure against the possibility of slipping or loosening under heavy or intermittent cuts. The teeth are easily adjustable when they become worn and it is possible to set the cutters at the best angle for the work in hand.

The body is made of hardened steel and is ideal for holding Stellite teeth, which are supplied if so ordered. The cutter is made in sizes ranging from 6½ to 18 in. in diameter.

Keller "Rivet-Busting" Tool

The Keller Pneumatic Tool Co., Grand Haven, Mich., is placing on the market the tool shown in the illustration, which is called the Keller "Iron Mule" "rivet buster." This is an air-operated tool designed for cutting off and backing out steel rivets in the shop. It



KELLER "IRON MULE" "RIVET BUSTER"

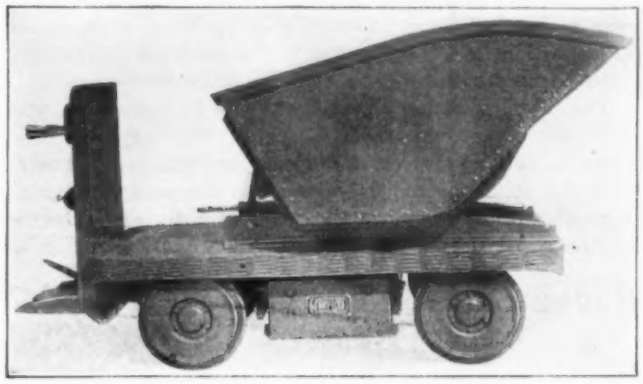
Specifications: Dimensions of piston, 1¾ x 9 in. Length of stroke, 41 in. Length of chisel, outside of tool, 7 in. Length of tool, overall, 67 in. Net weight, 75 lb. Weight of chisel, 7 lb. Operating weight, 82 lb. Shipping weight, 135 lb.

is simple in operation, requiring no special skill. Three men are needed to operate the tool to the best advantage, two being at the throttle end while the third supports the chisel end and holds the chisel to the rivet. The air-control handle is located under the operator's right hand and the force of the blow is entirely under his control. It is claimed that ¾-in. and 1-in. rivet heads can be cut off in from four to six blows.

Dumping Body on Karry-Lode Industrial Truck

The all-steel dumping body illustrated can be mounted on the electric truck made by the Karry-Lode Industrial Truck Co., Inc., 98-100 Nott Ave., Long Island City, N. Y. The body has a capacity of 40 cu.ft. and dumps over the end of the truck, being especially adapted for coal handling.

The mounting of such a body is possible because of the fact that the truck is so constructed that it is not necessary to raise the platform to gain access to the



DUMPING BODY ON KARRY-LODE INDUSTRIAL TRUCK

battery. The steel platform serves as the frame of the truck, and the battery is so suspended that it can be removed without disturbing the platform.

Torchweld Gas Cutting-Torch

The gas cutting-torch shown in Fig. 1 is made by the Torchweld Equipment Co., Fulton and Carpenter Sts., Chicago, and is known as their style 15 MC. It is designed to use oxy-acetylene, oxy-hydrogen, or oxy-hydrocarbon gases, such as butane, calorene, and the like. Special tips, however, are needed for the various gas combinations. An 85-deg. torch-head angle is standard but 70, 50, 35 deg. and straight heads can be furnished when desired.

A one-piece cutting tip is used and the mixing chamber is just back of the torch head. A novel feature of the construction is that an annular space is provided around the mixer in which a small amount of gases accumulate. Drill holes connect this space with the gas passage-way leading to the tip and, in case of

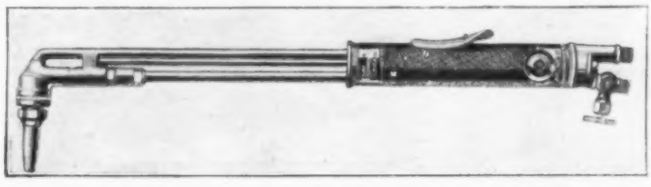


FIG. 1. TORCHWELD GAS CUTTING-TORCH

back-fire to the mixing chamber, the ignited mixture in the annular space is designed to blow out the back-fire and eliminate the hazard of flash backs into the flexible connecting hose.

All the gas-tight seats in tips, needle valves and connections, are of the line-contact type: In other words, a convex surface is brought into contact against either

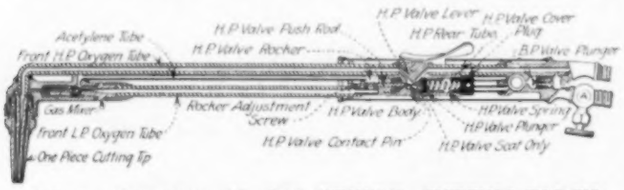


FIG. 2. DETAILS OF TORCHWELD CUTTING-TORCH

a flat surface or another convex surface. A tight seating is thereby much more easily obtained than by using two flat surface contacts.

One of the difficulties experienced with two-hose type cutting torches is the back pressure of the acetylene into the oxygen hose. Under certain conditions this results in the oxygen hose becoming filled with mixed gases which ignite at the tip and a more or less serious flash back into the oxygen hose is unavoidable.

The Torchweld back-pressure valve is claimed to prevent the acetylene from entering the oxygen hose, since a certain pressure on the oxygen is necessary in order to open this valve, and as the acetylene pressure also tends to close the valve still tighter. Details of the construction of this torch are shown in Fig. 2.

Ransom No. 109 Tool Grinding Machine

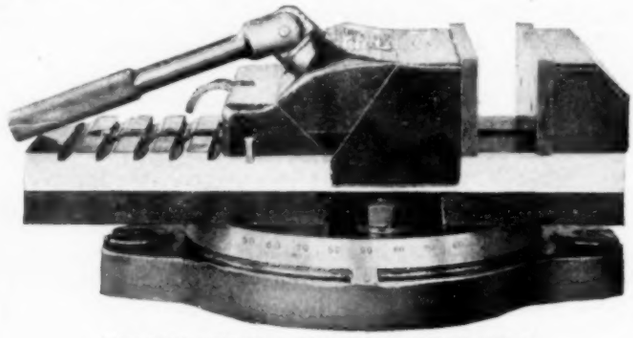
The motor-driven ball-bearing tool-grinding machine illustrated is manufactured by the Ransom Manufacturing Co., Oshkosh, Wis. It was designed as a utility grinder to be placed in any convenient place and does not require a great deal of floor space. The motor is a General Electric ¾-hp., alternating current, 60 cycle, 2 or 3 phase, any voltage. A quick make and break oil switch is used. The machine is started by stepping upon either of the two pedals at the base. When the foot pressure is released the machine automatically stops. The bearings are SKF self-aligning and the arbor is of high carbon steel. Cast-iron guards as shown are included in the regular equipment.

Specifications: Abrasive wheels, 12 x 1 in. Wheel flanges, 6 in. Diameter of arbor where wheels go on, 1¼ in. Distance from floor to center of arbor, 38½ in. Length of arbor, 19¾ in. Size of base on floor, 17½ in. Weight complete, 489 lb. Speed, 1,800 r.p.m.

RANSOM NO. 109 TOOL-GRINDING MACHINE

Nelson Quick-Acting Machine Vise

The Nelson Tool and Machine Co., Inc., 82-88 Llewellen Ave., Bloomfield, N. J., has brought out the machine vise illustrated. The screw operating the sliding jaw is set at an angle so that when pressure is exerted in

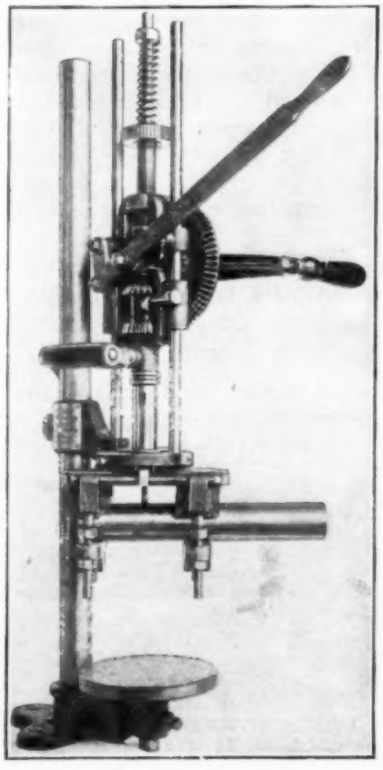


NELSON QUICK-ACTING MACHINE VISE

holding work the wedge block forces the jaw against the bottom of the vise, making it impossible for the jaw to tilt upward. It is claimed that a hammer is not required to bed work down on either the vise bottom or on parallels. The vise is made in two sizes. No. 1 has jaws 6 in. wide and 2 in. deep; opening 5¾ in. No. 2 has jaws 4 in. wide and 1½ in. deep; opening 4 inches.

Glaude Universal Portable Drilling Machine

Leopold F. Glaude, 930 N. Washtenaw Ave., Chicago, Ill., has brought out the drilling machine illustrated herewith. All the working parts of the machine are mounted on a 1¼-in. tubular-steel column from which they can be readily removed and clamped to the flat surface of any work that is to be drilled. The machine is operated by hand, has a two-speed change gear, and both screw and lever feed. A centering chuck and a V-block chuck are provided. By clamping a shaft in the outer V-block and having the inner V-block slightly loose, keyways can be cut in the shaft by means of a two-lip tool, the feeding being accomplished by means of a right- and left-hand screw that actuates the V-blocks. Power can be applied to the machine through a flexible shaft.

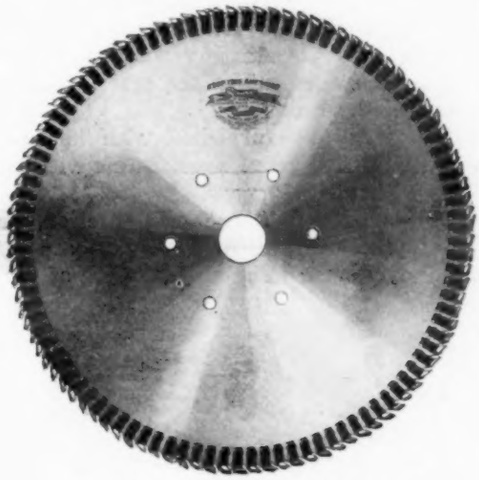


GLAUDE UNIVERSAL PORTABLE DRILLING MACHINE

Specifications: Column, 1¼ x 30 in. Will drill to center of 7-in. circle. Capacity, 0 to ¾ in. drill. Table, 6 in. diameter. Hole in spindle, No. 2 Morse taper. Weight, 45 lb.

Simonds No. 000 Inserted Tooth Metal Saw

An inserted-tooth metal saw designated as No. 000 is being placed on the market by the Simonds Manufacturing Co. of Fitchburg, Mass. This saw was especially designed to meet the requirements for a saw to cut structural iron, I-beams, channels and stock with thin walls that could not be cut as successfully with other saws of similar design, because the pitch or spacing of the teeth was not fine enough to keep two teeth in the cut at all times in this work. Through its arrangement and closer spacing of teeth this saw provides for smoother running and is claimed to eliminate the chatter often noted where the teeth are placed further apart in the plate.



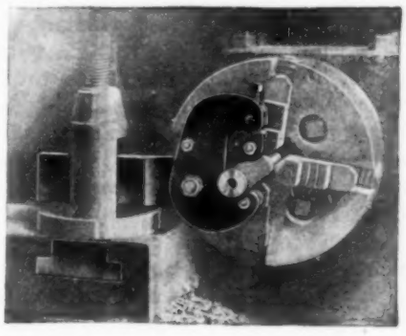
SIMONDS METAL-CUTTING SAW

These saws are being made from 10 in. in diameter, having a maximum of 40 teeth to cut a $\frac{1}{4}$-in. kerf, to 50 in. in diameter having a maximum of 240 teeth to cut $\frac{1}{32}$- or $\frac{1}{16}$-in. kerfs.

Newman Knurling Tool

The knurling-tool shown in the illustration has been placed on the market by the Newman Manufacturing Co., 717 Sycamore St., Cincinnati, Ohio. The tool carries two knurls, placed on opposite sides of the work. It is claimed that, since there is no side-thrust on the work, it is not necessary to use the tailstock center and that very high speeds are obtainable.

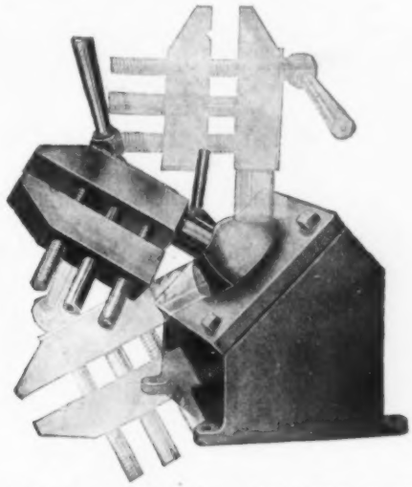
The tool is furnished with one set of standard knurls, cut either checkered, helical or straight with pitches of either 32, 20 or 14 lines per inch. All parts are of steel. The knurls are easily removable and the distance between them can be varied by means of a screw adjustment. The tool is made in two sizes, one for knurling stock up to 1 in., the other for stock between 1 and 2 in. in diameter.



NEWMAN KNURLING TOOL

Newman "Handi-Vise"

The device shown is being marketed by the Newman Manufacturing Co., 717 Sycamore St., Cincinnati, Ohio. It is intended for holding all sorts of small parts when drilling or machining them, being applicable to general shop use as well as tool and die work.



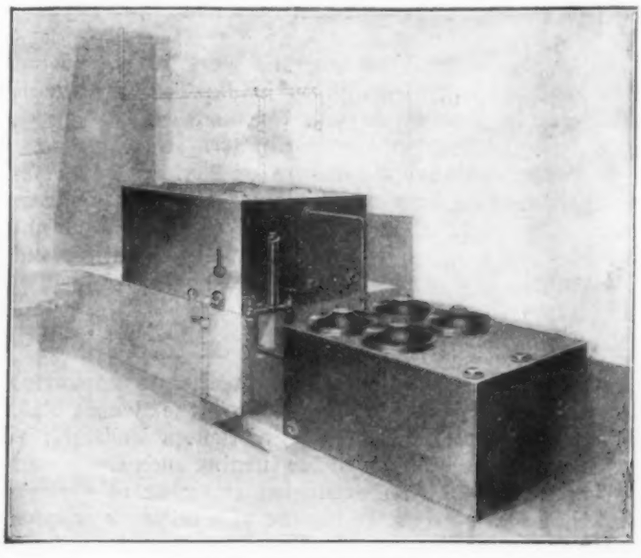
NEWMAN GIANT "HANDI-VISE" AND "GRIP-TITE" HOLDER

The jaws are opened and closed by turning the small lever, the two screws being geared together so that they operate simultaneously and keep the jaws parallel. One jaw is provided with a V for gripping round work. The parts are case-hardened. The overall length of the vise with the handle is 9½ in., the jaws are 1 in. wide and the maximum distance between them is 2¼ in.

The jaws can be used as a separate unit and held in a bench vise, but the base shown is known as the "grip-tite" and is intended for holding the jaws so that they can be adjusted to any position. The handle of the vise can be inserted in the ball, which is mounted in a socket. All parts of the base are made of steel.

Bowser 9-F Oil Filter

The filter shown in the accompanying illustration is a late addition to the line of S. F. Bowser & Co., Inc., Fort Wayne, Ind.

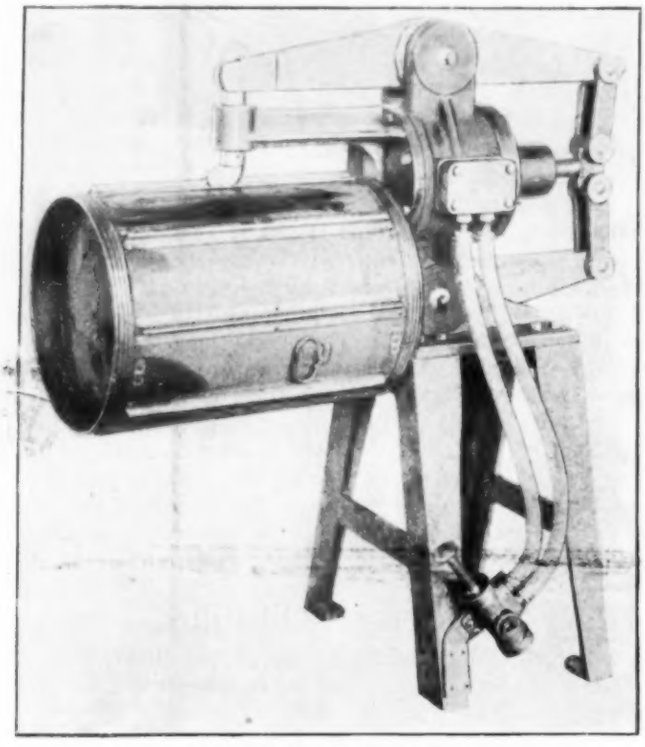


BOWSER 9-F OIL FILTER

The filter is intended for filtering and sterilizing oil used as a lubricant or coolant in metal cutting. The oil from the machines or chip separators is delivered to the filter, which automatically removes the foreign matter and sterilizes the fluid. After passing through a series of compartments, screens, filtering devices, etc., the oil is delivered to the filter tank which acts as a temporary storage. From this tank the oil can be returned to the machines, the same as new oil, and used again. Filters can be specially designed to fit individual conditions.

Baird Ash-Can Riveter

A riveter designed for riveting ash cans and shown in the accompanying illustration is being placed on the market by the Baird Pneumatic Tool Co., Kansas City, Mo. The machine has a four-way valve for operation by workman's foot, so that his hands will be left



BAIRD ASH-CAN RIVETER

free in placing and holding the work to be riveted. The dies are wide enough to bridge the reinforcing ribs on the side of an ash can and will drive two rivets, one on each side of a rib, at a single stroke.

It is claimed that a pressure of 35 tons is exerted on the dies with an air pressure of 100 lb. per square inch. The machine can be removed from the stand and mounted on a bench if desired. Weight, with stand, 740 pounds.

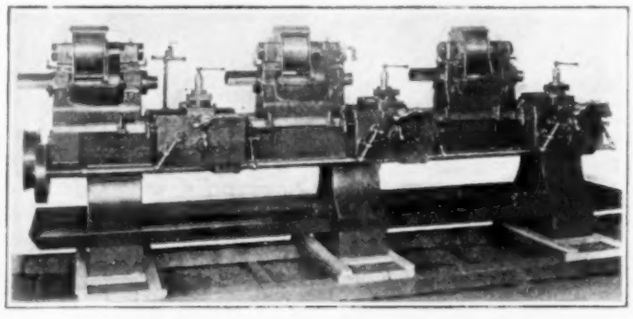
Seneca Falls Multi-Head Lathe

The multi-head lathe shown in the accompanying illustration has been brought out by the Seneca Falls Manufacturing Co., 387 Fall St., Seneca Falls, N. Y.

This machine is intended for turning such short work as can be held on an expansion arbor or in a chuck and that does not require the use of a tailstock or other form of outboard support. Three heads and carriages are mounted on one bed, the feed of all the carriages being driven from the same feed shaft. The lever at the right of each apron advances the tool to the work and at the same time engages the clutch for the longitudinal feed. When the carriage has traveled the proper distance the short lever at the upper left hand of the apron engages with a cam on the Vs of the bed throwing out the latch holding the tool to the work, allowing the tool to be withdrawn and at the same time engaging the quick-return clutch. The carriage then automatically returns to its starting position, where it is stopped by the engagement of the starting lever with another cam on the bed.

The machine can be furnished with heads having plain pulleys and back gears as shown or with two-step cone pulleys without back gears.

The apron is of double wall construction, and the clutches and practically all of the gears are made of heat-treated alloy steel. The rack is made of tool steel.



SENECA FALLS MULTI-HEAD LATHE

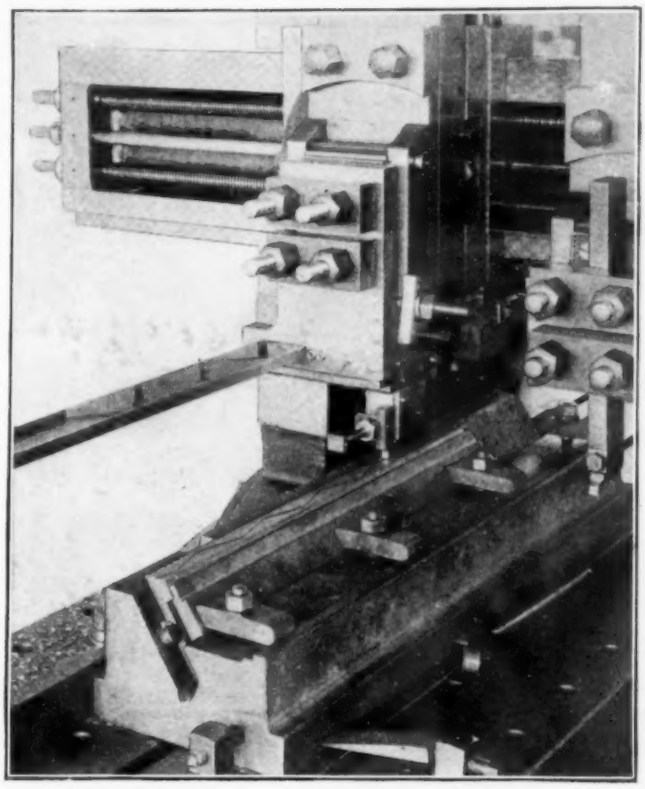
Specifications: Swing: over bed, 18½ in.; over carriage, 11½ in. Spindle: front bearing, 3½ x 5½ in.; back bearing, 2⅞ x 4½ in. Drive pulley, 6 in. face; 10½ in. diameter.

The feed drive is taken direct from the countershaft to a pulley at the end of the machine and from there to the feed shaft by silent chain. An oil pump is provided and ample provision has been made for returning used lubricant to the reservoir. The machine is thoroughly guarded.

Hanson-Whitney Oil-Groove Planing Tool

The Hanson-Whitney Machine Co., Hartford, Conn., has placed on the market the oil-grooving device shown in the illustration. It is intended for cutting oil grooves in slides, being used as an attachment on any standard planer. With it, zig-zag oil-grooves of regular and uniform character can be cut in plane surfaces. A V-shaped groove having a total angle of 120 deg. is made. It is claimed that this form of groove is superior to the half-round section groove, because it makes it easier to produce grooves of different widths with the same tool and also because it gives the oil an opportunity to wedge itself between the wearing surfaces.

The device proper is mounted on the clapper of the planer, and suitable means are provided for locking the clapper so that it cannot be lifted. The device itself has a small clapper box carrying the grooving tool and mounted on a cross-slide, its position on the cross-slide being adjustable. A bar cam is fitted in the body of the device, one end of the bar being attached to an upright strapped to the planer table, so that it moves with the work. The connection is made through both horizontal and vertical slides, so that considerable freedom of movement of the planer head carrying the device is possible.



HANSON-WHITNEY OIL-GROOVE PLANING TOOL

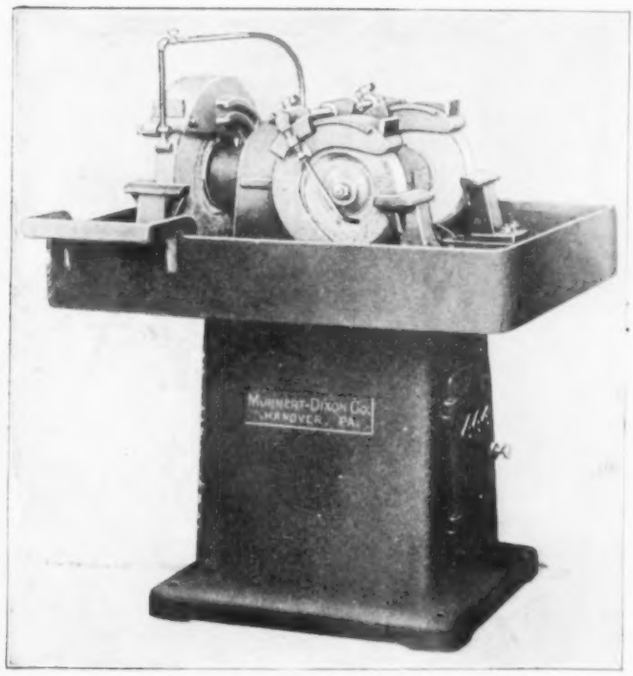
As the planer table travels, the follower in the cam groove is caused to reciprocate, its motion being transmitted to the grooving tool. Suitable means are provided for varying the stroke of the tool, so that the width of the zig-zag can be varied from ¾ to 1¼ in., its maximum length being 30 in. with the standard length cam-bar.

Grooving tools of three shapes are furnished. The one shown is used for most work. When cutting on an angle, as in V-shaped slides, the whole device is swung and a side tool is used. In order that the tools may be sharpened quickly and correctly, a block is furnished for holding them while they are ground on a cutter grinding machine.

Mummert-Dixon Oilstone Wet Tool Grinding Machine

The Mummert-Dixon Co., Hanover, Pa., has added to its line the wet tool grinding machine shown in the illustration. The machine is intended for general tool grinding in both toolrooms and machine shops, and is provided with three wheels of different grades. It is thus possible to rough and finish a tool on the same machine, and for three men to be grinding at the same time. The wheel arbors are carried in ball bearings provided with oil retainers. The arbor carrying two wheels runs at half the speed of that carrying the single wheel, being driven from it through bevel gears enclosed in an oil-tight case. The machine can be driven either by motor or by belt, a countershaft being furnished in the latter case. For individual-motor drive, the motor is mounted in the base of the machine and belted to the driving pulley, a belt-tightener being provided.

Kerosene is used as a coolant, being distributed to the wheels by a small centrifugal pump located at the bottom of the oil reservoir. A large pan is provided to



MUMMERT-DIXON OILSTONE WET TOOL GRINDING MACHINE

Specifications: Size of wheels; coarse, 16 x 2 in.; medium and fine, 10 x 2½ in. Speed; coarse wheel and pulley, 1,350 r.p.m.; medium and fine wheels, 675 r.p.m.; countershaft, 450 r.p.m. Driving pulley, 6 x 4½ in. Countershaft; length, 24 in.; drop, 12 in. Motor, 3 hp., 1,800 r.p.m. Floor space, 33 x 41 in. Net weight, 1,075 lb.; with countershaft, 1,285 lb.; with motor, 1,300 lb. Gross weight; crated, about 1,400 lb.; boxed for export, about 1,500 lb. Export box, 36 x 44 x 48 in.

catch the kerosene thrown from the wheels. It is claimed that the use of kerosene keeps the wheels clean and sharp, as well as preventing over-heating of the tools being ground.

Williams-White Tie-Rod Presses

The two large presses illustrated herewith have been recently completed by Williams, White & Co., Moline, Ill. Both machines were designed for blanking out side

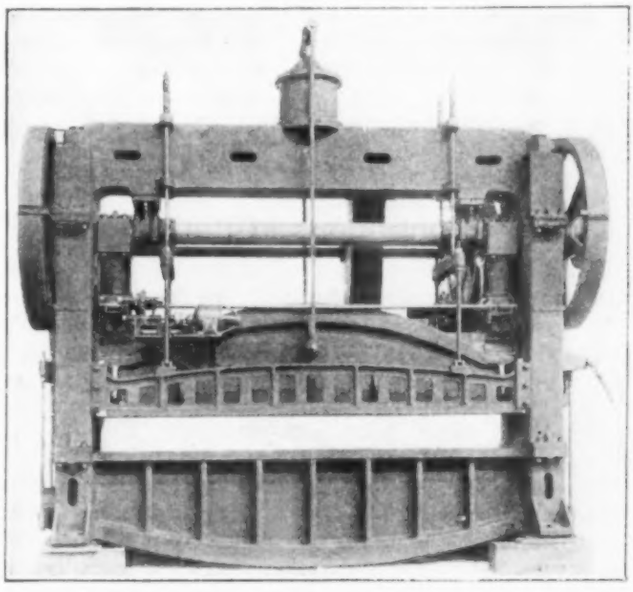


FIG. 1. WILLIAMS-WHITE 500-TON PRESS

Specifications: Capacity, 500 tons. Distance between housings, 16 ft. Width: table, 30 in.; ram face, 30 in. Die space: Maximum, 23 in.; minimum, 11 in. Stroke, 7 in. Openings in housings, 24 in. Height, 21 ft. Length, 21 ft. 10 in. Width, 10 ft. 6 in. Stroke per min., 12. Motor, 75 hp.

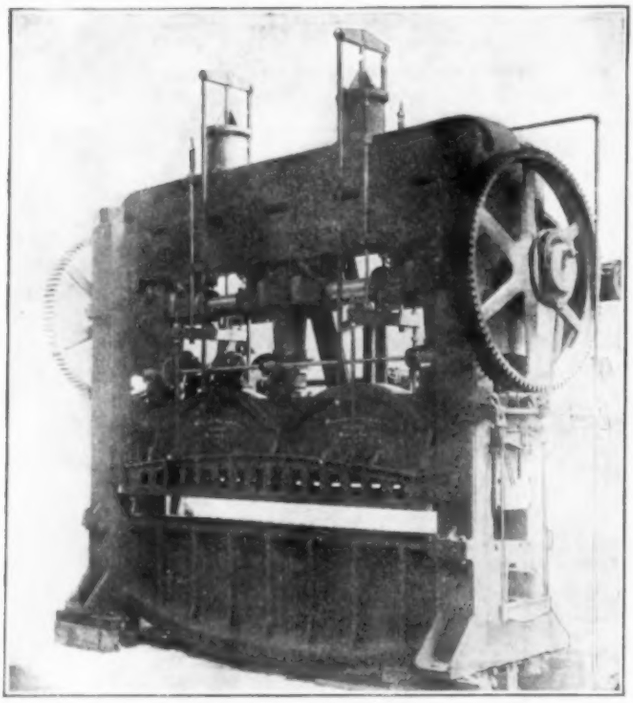


FIG. 2. WILLIAMS-WHITE 800-TON PRESS

Specifications: Capacity, 800 tons. Distance bet. housings, 18 ft. Width: table, 30 in.; ram face, 30 in. Die space: Maximum, 23 in.; minimum, 11 in. Stroke, 7 in. Openings in housings, 24 in. Height, 24 ft. 7 in. Length, 24 ft. 9 in. Width, 13 ft. 2 in. Strokes per min., 8. Motor, 100 hp.

rails for motor vehicles, the press shown in Fig. 1 for pleasure cars, and that in Fig. 2 for trucks.

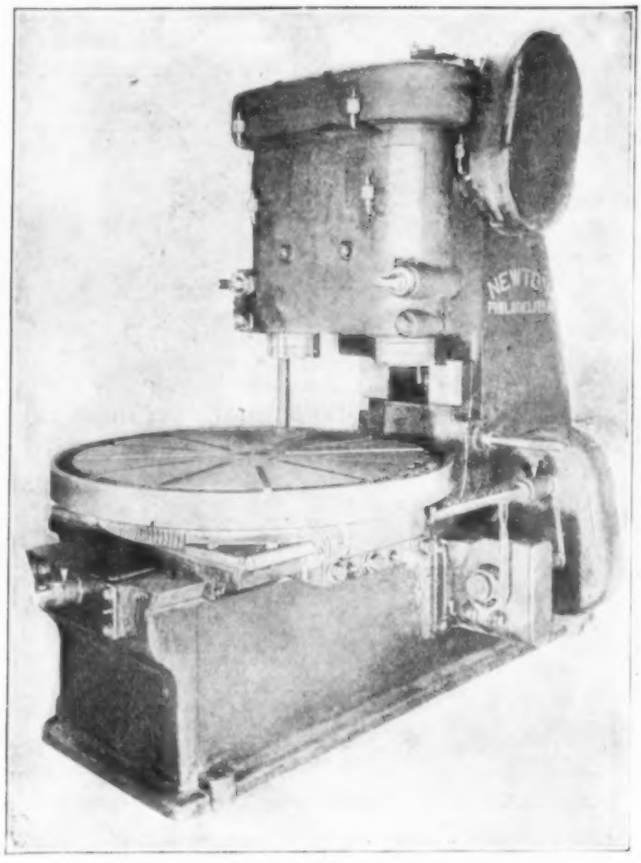
All gears and operating parts are located overhead so that the work can be placed in and removed from the machine from the front, back or either end. For this purpose the uprights have ample openings between the tie-rods. The ram adjustment is by screws in the pitmans, operated through worm gearing by a motor mounted on the ram. The strippers are operated by cams on the crankshaft. The table has four T-slots and an opening 6 in. wide in the center of its length. The ram face has five T-slots. The clutch is of the friction type and an automatic stop and brake are provided. The crankshaft is driven from both ends to equalize the drive and eliminate torsional lag. An automatic knockout is connected to, and operated by, the ram.

Newton Continuous Milling Machine

The illustration shows a rotating-table type of continuous milling machine built by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. This is the first of the continuous milling machine models brought out by the concern.

The column and base are cast in one piece, in order to eliminate a bolted joint between them. The table is circular in form, with provision for mounting the fixtures necessary for holding the work; and it is adjustable upon the base, in order to provide for the proper positioning of the fixtures. Tables can be furnished either 24, 36 or 48 in. in diameter on their working surfaces. A pan for draining the lubricant when working on steel surrounds the table.

A fixed feed controls the rotative movement of the table, so that it is not possible for the operator to change the production of the machine without attracting the attention of the man in charge. There is, however, provision for changing the rate of feed.



NEWTON CONTINUOUS MILLING MACHINE

The spindle head is equipped with two spindles, the height of each being independently adjustable for setting the cutters. The left-hand spindle is used for the roughing operation, and the right-hand spindle for finishing. The distance between the centers of the spindles varies from 13 to 22½ in., depending upon the size of the table used, so that long pieces can be completely machined in the roughing operation before the finishing cutter starts on them. It is claimed that, owing to the small amount of work performed by the finishing cutter, accuracy of both finish and dimension is maintained with only infrequent grinding of the cutters, and that high cutting speeds and feeds can be employed.

The machine is driven through worm gearing by an individual motor mounted on the side of the column. The head carrying the spindles is adjustable on the column, in order that the holding device for the work may set as flat or low on the table as the castings will permit. All driving gears are hardened, enclosed and run in oil. The bearing surfaces are large both on the slides and on the rotating shafts.

The eleventh annual convention of the American Manufacturers' Export Association will be held at the Waldorf-Astoria, New York, Oct. 14, 1920. This convention will be limited to a one-day session, followed by a banquet in the evening. The keynote of the convention will be: "To obtain permanent world trade, American manufacturers must now take a leading part themselves." The part that they must take to obtain this permanent world trade will be discussed by the President, W. L. Saunders.

What the Steel Industry Thinks of the Compulsory Metric System

THE total annual ingot capacity of the steel producers of the United States is estimated at approximately 55,930,940 tons.

The Association of American Steel manufacturers, the membership of which is composed of forty of the leading concerns in the steel industry, represents an approximate total annual steel ingot capacity of 47,106,460 tons.

The principal class of materials manufactured by the members of this Association, from the ingot tonnage referred to (which does not include castings), is as follows:

> Structural steel shapes for bridges, buildings, cars, ships; plates for all structural purposes; boiler plate; hot and cold rolled bars for automobile, agricultural and general trade; small and special rolled shapes; bars for concrete reinforcement; hoop, band and strip steel; sheets and tin plate; welded pipe; seamless tubing; wire rails and track accessories; forgings of all kinds; wrought steel wheels; etc., etc.

During the month of March, 1920, a canvass of the members of this Association was made on the subject of the metric system. In reference to this the Secretary writes as follows:

Association of American Steel Manufacturers,
Pittsburgh, Pa., Aug. 13, 1920

It was decided to ascertain definitely the present attitude of our member companies on the *compulsory adoption* of the metric system in the U. S. without prejudice to their opinions as to the merits of the system. The result was:

Thirty-seven companies voted *against* the *compulsory adoption* of the metric system in the United States.

One company having an ingot capacity of approximately 0.5 per cent of the total capacity represented in the Association of American Steel Manufacturers, voted neutral.

One company having an ingot capacity of approximately 0.7 per cent of the total capacity, voted in favor.

One company having an ingot capacity of approximately 2.5 per cent of the total capacity, did not reply.

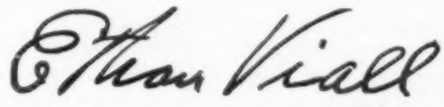
J. O. Leech, Secretary.

From the above the following figures are of interest:

96.3 per cent *against compulsory use* of *metric system*
0.5 per cent neutral
0.7 per cent in favor of metric system
2.5 per cent no preference expressed

The importance of the steel industry in the life of the nation is indicated by the fact that conditions prevailing in it are considered the best available business barometer. When the steel industry is prosperous, the country at large is prosperous. The stand taken therefore by this industry on the important subject of weights and measures is most significant and compels attention.

In connection with the foregoing we wish to call attention to the fact that last February the Pittsburgh Chamber of Commerce voted *unanimously* against making the use of the metric system compulsory.



Editor

WHAT to READ
—for the man in a hurry

Suggested by the Managing Editor

HOW much is a thousandth of an inch? Some people look with scorn upon this insignificant quantity and scoff at its usefulness while others apparently think only in such units. As to the respective merits of these divergent views we have nothing to offer just now although we have our own opinion on the subject. It is sufficient that the above-mentioned unit seems to have come to stay and consequently must be measured. For this purpose the micrometer is without doubt the best known device. Its manufacture, in view of the fact that any measuring device must be made to a higher degree of accuracy than the part which it is to measure, involves problems that interest all mechanics, theoretical, practical or "near." The first article in this issue goes into the matter in some detail.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

While we are discussing this subject of splitting hairs it will be well to mention that a thousandth of an inch is a big, clumsy thing to the experts at the Bureau of Standards. They actually work with millionths and aspire to ten-millionths, values quite beyond the comprehension of the average citizen.

For testing micrometers we usually employ the more accurate modern gage blocks. When it comes to testing the gage blocks something still more accurate is necessary and we must pass to the methods of the laboratory. These methods are explained by C. G. Peters and H. S. Boyd, of the Bureau, in an easily understandable article which begins on page 627 and will be concluded in our next issue.

The production and planning section of Mr. Basset's "Modern Production Methods" ends with Part IX which appears on page 619. Part X which we expect to publish two weeks hence serves as an introduction to the second section of this important series, in which the subject of cost accounting will be taken up. Mr. Basset in this article calls attention to the fact that the fixing of the sales price by basing it upon a cost analysis is only one of the many uses to which sensible cost accounting may be put.

On page 613 we have an account of the Y. M. C. A. industrial conference at Silver Bay by a member of the staff.

We feel that a word of explanation is in order concerning the material on pages 616 and 617. The word "modern" in the title of this brief description of four aviation engines was strictly correct when the story was written. We regret to say that the drawings were held up so long in our drafting room that the use of "modern" is open to question. With this word of explanation, however, we are going to let it go.

The season for "new tools" has opened with a bang. After the usual dull summer (dull so far as announcements were concerned) we have a regular rush on new machines, tools, and devices which begins on page 635 and is still being added to as this page is written. Production in our shops may have been running along at a reduced rate per shop and per man but the hard-working designers and engineers who never heard of a forty-four-hour week, have apparently been running true to form and doing their usual bit to supply the improved machinery with which to increase our lagging output.

On page 650 is a letter from our London editor written during the first week of September. He discusses the impending coal strike in England and points out the possible grave results to industry in general. It is not a cheerful picture. And to make it worse the price of petrol has suddenly been jumped. We feel aggrieved at being charged thirty-five cents for gas but what would we do if the price went to a dollar? Yet that is what it costs John Bull for joy-rides.

Another adverse view of the advisability of switching from English to Metric units is supplied by our Washington correspondent on page 647. This one comes from the Committee on Technical Standards of the Bureau of Surveys and Maps.

For the benefit of the engineers who read the *American Machinist*, L. C. Morrow, our assistant who occasionally takes a hand in the construction of this page, has prepared a list of all the references made in this paper to the Federated American Engineering Societies.

EDITORIALS

A Very Important Meeting

A MEETING of importance to everybody is to be held in Washington, in November—of importance to everybody because it will be the first meeting of the American Engineering Council, which is the managing body of the Federated American Engineering Societies.

We may safely assume that the Federated American Engineering Societies will act along the lines for which it was organized, namely, "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern in the engineering and allied technical profession." Hence the importance to *everybody*, who, of course, are the public, and who are concerned, day in and day out with things in which technical knowledge and engineering experience are involved. As the relation of the engineer to the public has been aptly expressed, *"Everywhere you look you see what the engineer has done.'* Try it.

The engineer is going to continue to do things everywhere to benefit the public, and he is going to do more of these against less resistance. This is going to be possible because of the Federated American Engineering Societies, which, again let it be said, has for its object, "to further the public welfare." As a concomitant result the engineer himself will benefit—will at last receive that recognition for service which he has long merited.

The American Engineering Council will have many or few (comparatively) members when it meets November 18, depending upon the action of engineering and allied technical societies between now and that time. Delegates to the organization conference, officers and just plain members of societies should at once do all they can to get their societies to apply for membership in the Federation. To help them get together ammunition for this task, should any be needed, we are publishing, page 646, a complete list of articles on the Federated American Engineering Societies that have appeared in *American Machinist*—articles that tell the why and the wherefore of the Federation and of its objects, purposes and progress.

Engineers, this is to be a great meeting, of the greatest engineering organization in the world—and it is to deal with the future work of the organization and determine the more important problems that should receive immediate attention. Is your society going to be a member, with its representative at the Washington meeting on November 18? L. C. M.

Technical Map Committee Recommends English Measuring System

ON page 647 will be found extracts from the report of the committee on Technical Standards, Bureau of Surveys and Maps.

This report shows that the committee *unanimously* recommends the use of the English measuring system for map work. The reasons advanced by the committee for its stand, are clearly given and furnish several mor nails for the coffin of the compulsory metric advocate

To the unthinking mind the metric scaling of maps might seem the better way, but these map experts know their business.

Keeping Contracts

AFTER the late Kaiser had declared his most solemn contracts and treaties to be "mere scraps of paper" to be repudiated when he felt strong enough to do so, and could force them down the throats of the other parties—

And—after this same late Kaiser had been relegated to the scrap pile for his uncivilized views, one would think the world in general would have considerable respect for deliberately drawn contracts.

However, numerous organizations, as well as some individuals, still have the "kultur" streak that showed so yellow in the Kaiser's spine.

A recent instance is the threat of the "outlaw" anthracite coal miners to violate their pledge to stand by the decision of the Joint Commission when the wage award was made.

President Wilson, for once, has made the proper stand in insisting that the miners abide by the decision, as they had agreed to do.

Either these miners must mine coal as they contracted to mine it, or be branded as outlaws who have no respect for their pledged word or the rights of others.

Contracts deliberately made must be kept, and this applies impartially to both parties to them.

We hold no brief for the coal operators, for had they refused to abide by the decision we would be as prompt to criticize them, but a contract is a pledge made to be kept and the miners are trying to welch on theirs.

We all despise a "welcher" and the scorn of the American people is on those radical leaders who are misleading the miners into an unsportsmanlike stand on the issue.

Outlaw methods will fail in America as surely as they did along the Rhine. E. V.

What Is An Open Shop?

THE Jersey City Chamber of Commerce recently asked its members to indicate their views regarding the "open shop." The result was 827 to 0 in favor of the "open" and against the "closed" shop. Of the 116 manufacturing plants at present operating in Jersey City, 96 are open and 20 are closed.

A "closed shop" as it is understood today only permits the employment of members of a Union. This is unsound economically and absolutely un-American, and as such cannot possibly succeed.

However, the so-called "open" shop is often in reality a "closed" shop, inasmuch as only strictly non-union men will be employed. Is not this type of open shop just as un-American as the other?

It must be admitted that unfair methods of outside agitators are largely responsible for this, since many employers feel that union workmen furnish a vantage point for the agitator to work from.

Whatever the cause, an "open" shop that discriminates against a man solely because he belongs to some organization is putting itself in the same class as the closed shop, and is on the wrong track.

E. V.

Some of the Advantages of the Left-Hand Lathe Carriage

By Francis W. Shaw
Manchester, England

The venerable lathe that figured in the story of F. M. A'Hearn on page 1243, Vol. 52, of *American Machinist* was probably a Britisher. Anyway, that is the way the normal British lathe is built (the abnormal ones being those that are obvious copies of American machines) and I would suggest to Mr. A'Hearn that from our point of view the "left hand" (we should call it "right-hand") carriage is right.

Most British lathes have coarse-pitch lead screws; four threads per inch up to 13 in. swing and two threads per inch above that size. American lead screws are comparatively fine pitch; six and eight threads per inch being common. Whereas the American "turnist" almost invariably employs a backing belt when cutting a thread, his British cousin backs his lathe only upon the exceptional fractional pitches. Indeed, few British lathes are equipped with a reversing countershaft.

But, really, I don't see how the position of the traversing handwheel causes the "uninitiated victim to get balled up," for the cross-feed handle is in the same position whatever the arrangement—about central with the cross-feed slide.

How would Mr. A'Hearn manage in a British shop where the lathes are half and half?

Let us inquire into the advantages of what Mr. A'Hearn calls the "left-hand carriage." "First, when the carriage is returned by hand it is easier for the man who is not left-handed or ambidextrous to do the traversing with the right hand while disengaging the nut is a light job and easily accomplished with the left hand. It must be remembered that both hands are employed as the tool approaches the end of the cut, one in withdrawing the cross-slide and the other in disengaging the nut. One hand must then be transferred to the traversing handwheel.

Second, the majority of screws are right-handed; hence during the cut the traverse is toward the headstock and toward the operator if he is standing in such position that the cross-slide handle is convenient to his hand, whether that hand be right or left. I submit that from this position it is easier to traverse the saddle back with the right hand because the handwheel is then receding from him, and it is easier to stretch out the right arm to the right than it is to allow the handwheel to pull the left hand in the same direction, past the operator's body. When the work is long it is easier for the workman to follow up the handwheel than it is to have it follow *him* up.

Third, the right hand of the average man is more sensitive than the left. The handwheel to the right is, therefore, better when one is feeding the cut along toward a finish under a shoulder after the power feed has been tripped for the reason that the action of the tool can be better judged from the feel by the sensitive right hand than by the left. The right hand too has more power over the shipper; hence, when the reversing belt is in use it appears more natural to stand with the right hand on the shipper-bar ready to reverse immediately the tool is withdrawn by the left.

A far worse condition than the disposition of the traverse wheel is, in my opinion, imposed by having part of the footstock screws of right-hand lead and others of left-hand. The writer was at one time operating two lathes, one British and the other American. A heavy job was swung between the centers of one of them, and going from one to the other to note how the job was coming along, I noticed that the centers had worn loose. Giving the handwheel a quick turn to, as I supposed, tighten up the centers, the heavy piece dropped out of the lathe with disastrous results.

Articles Concerning the Federated American Engineering Societies Which Have Appeared in the "American Machinist"

The following list is an index of all articles, editorial, news and general, concerning the Federated American Engineering Societies, which have appeared in the *American Machinist* since the organizing conference held in Washington, D. C., June 3 and 4. It is published to enable our readers to refer without undue trouble in searching through back numbers, to any or all of our articles on the Federation, which we believe, furnish a complete and accurate report of the inception, organization, objects and progress of that federation of societies.

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Committee on Technical Standards, Bureau of Surveys and Maps, Recommends Use of English Measuring System

A VIGOROUS stand for the English system of measurements was taken Sept. 14 by the Committee on Technical Standards of the Bureau of Surveys and Maps. A portion of the report made on that occasion by the committee is as follows:

A review of the answers of the various Bureaus to a questionnaire develops an outstanding feature which it is believed should have the attention of the Board without delay. This is the question of whether maps should be published on standard scales of metric or English measurement. By metric measurement is meant the practice of employment of "ratio" scales evenly divisible into one million, such as 1:62,500, 1:250,000, etc. By English measurement is meant the scales upon which one inch on the map bears an integral relation to feet or miles on the ground, as for example, 1,000 ft. to 1 in., 2 miles to 1 in., etc.

Four of the reporting Bureaus evidently employ the metric scales almost exclusively, while eight, on the other hand, use the English system. Two use both, and three agencies report that they do not make maps. From this it would seem the weight of opinion inclines heavily to the English system, but it must be pointed out in this connection that two of the largest map-making organizations, namely, the Geological Survey and the Coast and Geodetic Survey, employ the metric system. All the commercial map concerns of the country and the state, county and municipal governments use the English system, except in rare instances. Practically all maps dealing with the public land surveys of the country are made on the English measurement scales, since the metric scales do not lend themselves at all readily to the chain unit employed on cadastral surveys.

In the opinion of the committee, there is no reasonable argument opposed to the desirability of all government map-making organizations uniting upon one system or the other and after due consideration of the various phases of the question the committee has reached a unanimous conclusion to recommend to the board that the English system be adopted as standard practice. The committee is not prepared to recommend the various scales in the system which should be chosen as standard, but merely suggests the acceptance of the general principle.

This decision was made not only from the standpoint of securing uniformity in government maps, but also because the advantages of the English system over the metric are so apparently overwhelming that there seems little excuse for continuing the latter system.

Naturally, the greatest objection to the change is that so many of the maps are already published on the metric scales that great inconvenience would result in fitting new work to that existing, and great expense would be involved in ultimately making the old maps over. Probably the greatest difficulty would occur in the Geological Survey, but since only about 40 per cent of the country has been mapped so far by that organization, and admittedly half of this work must be re-surveyed to higher standards eventually, it would seem that it is not yet too late to make the change if it is clearly advantageous from other standpoints.

The widespread practice of using such scales as 1:62,500, 1:125,000 and 1:250,000 and 1:250,000 on the maps of the Geological Survey, the Coast Survey and the Lake Survey is of long standing, and while the reasons leading to the adoption of such scales are not entirely clear to the committee, it is surmised that the idea largely was to conform with European practice and to accord with opinions of scientific interests. It is believed, however, that the trend of scientific and professional opinion toward the adoption of the metric system in this country is not nearly so strong as it was 20 or 30 years ago. As an example in this connection, it seems desirable to draw the attention of the Board to the recent action of the Society of Automotive Engineers in adopting a resolution opposing the adoption of the metric system of measurement at a convention attended by 1,000 delegates from all over the United States. The opinions expressed to the convention on the question by prominent professional men are particularly interesting and pertinent in connection with consideration of the subject as far as it relates to maps.

Thomas E. Butterworth, associate professor of mechanical engineering at Lehigh University, stated:

"My college enthusiasm for the metric system did not survive my employment as an engineer in Germany, the chief metric country. I found the metric system was not in universal use there after a generation of compulsory legislation, and also found the use of the metric system was of no advantage in engineering computation.

"Further careful study for years has convinced me that the fancied logical advantages of the metric system are illusory and that the agitation in favor of its adoption is *harmful* to American industry and engineering education."

Dr. Humphreys, president of the Stevens Institute of Technology, expressed the view, based on his wide experience as an engineer and manager of industrial plants, that a compulsory law favoring the adoption of the metric system would be a fatal mistake, placing a tremendously heavy burden upon the industrial interests and involving millions and millions of dollars of expenditure. Dr. Humphreys stated further:

"To representatives of educational associations and institutions who may have been led into an endorsement of the metric system, I would say that, while naturally appealing to the workers in the laboratory as I am in a position to appreciate, I feel sure that to make a metric law compulsory would be a great *misfortune* to the country."

L. P. Breckenridge, professor of mechanical engineering at Yale University, emphatically declared that it was distinctly harmful to instill into the minds of college students ideas favoring impracticable changes in our basic standards instead of co-operating with the country's industrial interests.

It is believed that these expressions are timely and indicate a trend of opinion disposing of the theory that

we are approaching the time when our standard units such as the foot, the mile, the pound and the gallon will be supplanted respectively by the meter, the kilometer, the kilogram and the liter. In fact, it seems to the committee that the English system is so thoroughly interwoven into our lives that a change may perhaps never come about, and consequently there seems no occasion to hamper the present use of our maps by the employment of scales sympathetic to the metric system. As a matter of fact, such scales as 1:62,500 and the 1:125,000 are not even truly metric, but are a compromise between the strictly metric and the English measurement which possesses the advantages of neither. It is true that the two above-mentioned scales approximate the popular English scales of 1 mile to 1 inch and 2 miles to 1 inch, but the confusion, doubts and difficulties caused by the slight difference are so much a part of the experience of all engineers, not to mention the laymen, that it scarcely seems necessary to point out this objection. Apparently, the Geological Survey fully recognizes that such scales are not expressed in terms of popular understanding when it finds it advisable to print the following explanation on the back of each topographic sheet:

"The smallest scale is 1:250,000, or very nearly 4 miles to an inch. For the greater part of the country a large scale, 1:125,000, or about 2 miles to an inch is employed."

It is true that, with the aid of specially made measuring scales, the maps can be readily used, but when it is realized that the common old foot rule divided into inches is the only implement available to probably 99 per cent of the map users, even including the engineers, it would seem that the scale of the map should be made accordingly. In other words, the map users in general will employ the inch as a unit of measurement on the map, so it seems unmistakably desirable to have this unit represent a definite number of the feet or miles which are the common units of measurement on the ground.

Convention of American Society for Steel Treating

THE Commercial Museum, Philadelphia, Pa., was the scene of the second annual meeting of the American Society for Steel Treating, from Sept. 14th to 18th, inclusive. This was the first meeting, however, of the society under its present name, as the organization is now a consolidation of the American Steel Treaters' Society and the Steel Treating Research Society. It was stated that the total attendances at the convention was in the neighborhood of 15,000.

In connection with the convention, an exhibit of appliances and products of interest to steel treaters was held under the auspices of the society. The number of exhibitors and the floor space occupied were both about three times as large as last year at the very successful convention held in Chicago under the auspices of the American Steel Treaters' Society. The exhibit contained not only heat-treating equipment of all sorts from furnaces to pyrometers, but also displays by steel manufacturers showing their products and their processes.

The officers elected for the coming year are as follows: Colonel A. E. White, president; T. E. Barker, first vice president; T. D. Lynch, second vice president; W. H. Eisenman, secretary; and W. S. Bidle, treasurer. The Board of Directors consists of H. J. Stagg, E. J. Janitzky, F. P. Fahy and W. C. Peterson.

Technical sessions were held in the morning, afternoon and evening. The opening session on Tuesday was devoted largely to announcing the results of the election of officers, a letter ballot having been previously held, and to the report of the amalgamation committee. Thursday evening was devoted to a banquet and ball at the Bellevue-Stratford Hotel. On Friday, inspection trips were made to various Philadelphia manufacturing plants, as well as to the Navy Yards. No sessions were held on the closing day, so as to allow an opportunity for everyone to visit the exhibits.

It is not amiss to note that a very complete program of entertainment was provided for the visiting ladies, of whom there were about one hundred. From the headquarters at the Bellevue-Stratford, sight-seeing trips were made to the principal objects of interest in Philadelphia. The exhibits at the Commercial Museum also were visited, so as to show the women where their husbands were spending their time.

The success of the meeting and of the exhibition is due chiefly to the efforts of the committees managing the affair. The chairmen of the various committees in charge of the convention were as follows: A. W. F. Green, program and papers; H. H. Clark, exhibition; F. A. Hall, entertainment; W. M. Mitchell, plant visitation, and Mrs. D. K. Bullens, ladies' entertainment.

As for the technical sessions, it is interesting to note the wide variety of the papers, although all were strictly in the field of heat-treating. About seventy-five papers were presented, embracing such topics as hardening, pyrometry, laboratories, furnace design and fuel, and heat-treatment in many phases.

A few of the papers presented are here given in abstract. The first one, by Prof. Larkin, is of general interest to engineers, and caused much favorable comment.

Lessons Learned in the Manufacture of Munitions and Ordnance That Can Be Applied to the Peace-Time Pursuits of Industry

By F. V. Larkin
Head of Department of Mechanical Engineering, Lehigh University, South Bethlehem, Pa.

The object of this paper is to point out some lessons that can be learned from the industrial activities in this country during the period from 1915 to 1919. During that time the author was associated with the manufacture of some 3,000,000 projectiles and approximately 500,000 high-pressure seamless cylinders. The viewpoint is that of one in charge of production.

The lessons learned are of two types, those occurring in the realm of steel and those in the realm of human nature. Under the former heading, the problems found in the mill, forge shop and the heat-treating and testing departments are of especial interest.

It was found desirable to keep a complete history of each heat made in an open-hearth furnace, one of the reasons for this being the fact that the steel workers are usually very secretive about their processes and their work, especially when a heat turns out badly. Another very important point was that the chipping of the ingots at the rolling mill could be almost eliminated by the use of proper molds and proper methods of rolling. Pyrometers were found to be very valuable in the forge shops. In the heat-treating department, by using the proper educational methods, the workers were made to like recording pyrometers and to look upon them as aids in their work. In heat treating, time is the most important element, and it was found desirable to standardize the length of time required in all opera-

tions, such as charging, drawing and quenching, and not rely upon the judgment of the worker.

In the realm of human nature two things seemed to be particularly important, that is, trade secrets and specifications. Before the war a few companies had a monopoly on the manufacture of munitions of war; and the arts of systematic production, inspection and manufacture were considered as trade secrets. This made it necessary that vast and independent developments be carried on by the government when it decided to manufacture munitions on a large scale upon its entry into the war. "We soon realized that, knowing the fundamental principles which serve as a foundation for any secret or process, we had only to bring into operation a sufficient amount of logically directed and persistently applied energy and ability in order to duplicate or outstrip the achievements of our competitors." It is chiefly the spirit existing in an organization that counts in this regard.

It was found that the more strict the specifications set for the manufacturer, provided that they were fair and accurate, the better it was for all concerned. The requirement of very high-grade work not only allows the worker to take pride in the class of work that he is turning out, but it insures satisfactory results. In the case of the manufacturing concern under consideration, work was rejected by the plant's inspectors that was actually of a high enough grade to be passed by the government inspectors who reviewed the job finally.

Carburizing, Hardening and Tempering High-Carbon Alloy Steels in 130 Minutes

By R. L. Gilman
Experimental Heat Treater, Standard Steel and Bearing Co., New Haven, Conn.

In developing this title, the author proposes a correlation of metallurgy, mechanics and economics to the end that better, faster, and cheaper production may be obtained. Reference is made to a complete set of heat-treatments for either hot or cold shaped objects of high-carbon alloy steel, especially chrome-vanadium alloys requiring maximum hardness and strength and, above all, the greatest possible uniformity of both. It is assumed that the stock has been thoroughly annealed previous to working. The practice upon which the results are based is well beyond the experimental stage. It is possible to carburize eutectoid or hyper-eutectoid steel on condition that the very hard case produced be not detrimental to the product. Carburizing insures uniformity in carbon content and in hardness.

In the operations described, 130 minutes includes all the time during which a load of 130 lb. of steel is subjected to heating, carburizing, reheating for hardening, and tempering. Of this time, 120 minutes is required in the carburizing furnace, 7 minutes in the hardening furnace and 3 minutes in the tempering furnace. The work is handled only in charging the carburizer. Quenching, conveying and feeding are functions of gravity and mechanics, and are not assumed as requiring any time.

All furnaces are of the gas-fired, rotary, automatically controlled type. The character of the equipment insures uniformity of treatment as regards speed, length of treatment and temperature. It is thus possible to use high temperatures in the furnaces, the carburizer being charged at 1,620 deg. or even higher. The mass of the work insures slow heating and the tumbling or rolling insures uniform heating.

After two hours in the carburizing furnace, the work is dumped into oil and brought out in a few seconds by an endless chain of buckets, at a smoking heat. This partial cooling tends to eliminate the danger of cracking between carburizing and hardening. The work then passes through boiling hot soda solution to remove oil and to give a uniform temperature. The hardening furnace operates at a temperature of from 1,600 to 1,740 deg., depending upon the size and grade of steel. The feed or speed of travel is varied so as to get the work out with the proper temperature, this being determined by means of optical pyrometers. After the work is quenched, it is removed from the vat by a chain of buckets and fed automatically to the tempering furnace, which is of the same type as the hardening furnace and operates at a temperature of 600 to 800 deg. The speed is again varied to give the proper temperature to the work, which falls out at the proper time and accumulates in large boxes, where its mass insures slow cooling.

The quenching medium is cooled by circulation through an external cooling system and is delivered into the hopper with the work. A close inspection of the work is held after each quenching.

This method has produced excellent results, being suited for such work as ball races. A deep case is produced without showing any sharp lines. The advantages of the system are that it saves labor, gives uniformity of surface hardness and finish, and also saves time.

The Selection of High-Speed Steel for Tools

By Henry Traphagen
Metallurgist, Fastfeed Drill and Tool Corp., Toledo, Ohio

One of the problems confronting the tool manufacturer today is to obtain a steady supply of physically uniform high-speed steel. By physically uniform high-speed steel we mean steel that is free from pipes, seams, cracks, segregated carbides, decarbonizations and fiber; steel that will harden quickly and uniformly with a smooth velvety grain that is almost amorphous.

For a long time every shipment to our plant was carefully analyzed chemically. I have records covering over a thousand consecutive samples, and I believe there were just two samples that did not check up to the standard specifications. Such performance is a remarkable tribute to the efficiency of chemical analysis. But, about 30 per cent of all steel received was rejected for physical reasons.

Hardness testing by the sceleroscope and Brinnell machine on both annealed and hardened samples showed nothing, for we found very little connection between hardness and machine-shop performance. It seemed that ordinary routine testing would not solve the problem. You know the old adage about judging the pudding by eating it. Why not test steel by actually hardening it? This was found to be the solution to the problem. The procedure is as follows: A piece from each bar is hardened by pre-heating slowly and thoroughly at 1,650 deg. F. and then heating quickly in a furnace maintained at 2,400 deg., after which the piece is quenched in oil until cool. The hardened piece is broken transversely and longitudinally and the fracture examined with a small low-power pocket lense.

If the piece breaks evenly, we look for either fiber or excessive carbides and generally find one or the other in brittle steel. If the steel is decarbonized, the shiny crystalline ring is so apparent that it is found at a glance. A pipe may be uncertain in the transverse fracture, but the longitudinal break quickly shows it up. If the tungsten content is low, we generally find that the structure is coarse and crystalline. Woody fibrous structures are very common, but always show up in the longitudinal fracture. We never reject on a single test. The test must be fair and no amount of retesting is spared if there is the slightest doubt.

Is a clean, smooth, uniform structure any index of a tool's value? To answer this question we made up dozens of drills from what appeared to be excellent steel. These drills were tested, not in the laboratory, but in a heavy-duty drill press. They were jammed through foot after foot of heat-treated forgings, using very little lubricant. Then they were taken out of the press, bounced on a concrete floor time and again to test for toughness, placed in the drill again and the whole performance repeated. Such tests and others have proved many times the value of fracture tests in selecting high-speed steel for drills and other tools.

I am not under the delusion that fracture testing is anything new or novel, but I do know that this simple method of testing has not been given the consideration it deserves.

Business Conditions in England

By OUR LONDON CORRESPONDENT

LONDON, Sept. 3, 1920.

THE British coal miners' strike is scheduled to take place on Sept. 25. These columns have stated that the demand is ostensibly for an increase of 2s. a shift in wages with also a reduction of 14s. 2d. a ton on the price of coal to the household consumer, but there is more in the dispute than this. The mining workpeople and their advisers are clearly dissatisfied with the way in which the industry is being managed by the government and some are intent on nationalization. As to the voting, there can be no doubt about the figures, even if they do include a considerable number of lads of 14 or 15 years of age and upward—the necessary two-thirds majority was obtained. Of the total number of votes recorded—namely, 845,647—606,782 were for the strike and but 238,865 against. In no area was there a definite majority against striking.

Many of the mines are working at a loss, the areas where this is clearly the case being Cumberland and Westmoreland, Lancashire and North Wales, and the Midland district. A large profit per ton is being made in South Wales, Northumberland and Durham, and a very small profit in Yorkshire. The explanation in the last case is that South Yorkshire received permission to export 50,000 tons out of a total of about 20,000,000 tons mined annually, and Great Britain is making a profit out of the export of coal. However, the miners are asking for half of this profit.

Coal owners' profits are fixed by law at the pre-war standard plus one-tenth of any excess available. As the result of the export trade this excess is estimated to reach £66,000,000, and of the £6,600,000 thus accruing to the mine owners, half will be divided in certain proportion among collieries making excess profits, the remaining half being divided among the collieries in Great Britain according to their outputs. The £60,000,000 or so left is intended to be applied to the reduction of the national debt, but according to a rough estimate made the 2s. extra demanded per shift will absorb about £30,000,000 for the miners, while a reduction of 14s. 2d. a ton on household coal would account for the other half.

COAL STRIKE RESULTS ON INDUSTRY WOULD BE HAZARDOUS

The result of a coal strike on industry can be guessed. Estimates vary according to the particular circumstances. Many works will close down within a week, though some could of course struggle on for a month or two. There is some evidence that preparations have already been made by the government to insure a sufficient supply of coal to industries on which the actual life of the country depends. According to present signs the miners will not act by themselves. They form part of what is known as the triple alliance, including transport workers and railwaymen, and nothing is less unlikely than combined action, although this is not at the moment absolutely certain. In engineering there will probably be no such attempt to struggle on and keep as many men going such as occurred during the molders' strike; according to appearances most works will simply shut down. Even now, one leading machine-tool firm is in receipt of no more than one important order a week and the report is of steady discharges at another well-known firm.

An inquiry has been made which suggests that given a coal strike, within a week half the cotton industry will be shut down, so that more than a million and a half of workpeople will be unemployed, including, of course, the coal miners. By the end of two weeks the remainder of the cotton industry and most of the shipbuilders may close down, and after, say four weeks from the beginning, another half million workpeople will be unemployed, including, according to this estimate, 40,000 engaged in the machine-tool trade and 80,000 in the motor industries.

By apologists for the miners the strike has been described as unselfish. However, more people would believe this if the demand for an increase in wages were withdrawn, for reduction in the price of coal would not affect the miners—they get their supplies either free or at nominal rates whereas the household consumer pays according to locality and quality at the rate of £3 and more a ton. In London the price has lately risen owing to the increased railway rates for transport. As regards wages, the miner has already received increases greater than the present increase in living costs, even leaving out of account the reduction in their hours. The cost of living is, it must be added, steadily rising and will soon, according to estimates, be 170 per cent above the pre-war rate.

PRICE OF PETROL INCREASED

Industry has received another shock, relatively of a minor character, in the sudden increase in the price of petrol. All sorts of dire results have been prophesied. Petrol (gasoline) has been suddenly raised in price by 7d. a gallon, the price of first quality being from 4s. 3½d., the ruling price, to 4s. 7d. a gallon. According to predictions, by the beginning of next year when the duty of 6d. a gallon is removed, the price will be 5s. a gallon. Taxation (new) of pleasure cars will then be at the rate of £1 per horse-power. As is not unnatural, the increased price has led to a demand for a government scheme by which Great Britain shall be rendered independent of America for petrol supplies. But it is pretty clearly recognized that not for some years can supplies be raised in this country of sufficient quantity, if available. Consumers of petrol have noted, too, the curious fact that petrol being increased in price, benzol has also been raised in price. Indeed a special committee appointed by the Board of Trade reported at the beginning of the year that the National Benzol Association simply regulated its prices according to the price of petrol and not by the cost of production.

IRON AND STEEL TRADES SLOW

In the circumstances it was not surprising that at the last market of the London iron and steel trades very little business was transacted and it was reported that "the export trade shows a further falling off, there being further cancellations by eastern traders." The financial disturbance in Japan some time ago caused the cancellation of orders, and now India, of late no bad customer to the British machine-tool trade, is moving in much the same direction and the next few weeks may bring much anxiety to British exporters to that area.

Nearly three years ago at a meeting in the hall of the Institution of Civil Engineers here an attempt was made to regulate the training of engineers through a central organization. Not only were scholarships and so on to be awarded but apprenticeship was to be supported and in particular parents and guardians were to be informed and advised as to the best means by which their wards might enter the engineering trade or profession. A fund of about £1,200 was formed, chiefly by grants from engineering institutions, but proved insufficient, having been expended in printing, etc. Appeals were therefore made to about 250 firms, who were asked for subscriptions of say 10 guineas yearly; in response, about 30 firms agreed. The subscriptions received having been spent, a meeting was again called and held two days ago. As the result, the organization will probably be merged in the Federation of British Industries or the engineering employers' federation.

Two unrelated items may be added. The first is to the effect that a Leipzig correspondent reports that, business being bad, the Technical Fair of Leipzig which preceded the General Fair was nevertheless continued into that Fair, and the machine-tool and other exhibits were to be on view until Sept. 4. The other relates to a British firm concerned not

quite indirectly with motor cars. Several weeks ago information was given to the papers and well spread to the effect that, owing to foreign competition, nearly 2,000 workpeople would have to be discharged. The shares fell in market value very rapidly. Soon after the fall an announcement was made that a very considerable issue of bonus shares would be effected, and of course the shares rose again. No moral is added.

Finding Decimal Equivalents on the Slide Rule

BY WILLIAM H. KELLOGG

The numerous and diversified methods employed for keeping decimal equivalent tables in a handy and conspicuous place only tend to emphasize their importance. The application of the slide rule in this connection has been found very useful to the writer, inasmuch as at some times and places tables do not happen to be conveniently posted.

It is to be supposed that everyone making frequent use of the equivalents will have memorized the decimal values of all of the fractions as small as the eighths, and possibly some of the sixteenths and thirty-seconds. It will be noted that the fourths have two figures after the decimal point, the eighths three, the sixteenths four, the thirty-seconds five and the sixty-fourths six. To further aid the memory, observe that all of the decimal equivalents end with 5, and that the last two figures must either be 25 or 75. The last three figures will always be arranged as follows: Preceding 7 will be 3 or 8 and preceding 2 will be 1 or 6. If this rule be remembered, it will be observed that in obtaining the result on the slide rule the last or end figures can be supplied mentally.

For example, to find the decimal value of 13/16, set the runner on 13, bring 16 on the slide to coincide and read the result, which is 0.8125. The 0.81 of course, appears plainly and the 25, the end figures, are supplied. Taking 19/32, the result reads 0.59+, and the third figure looks as though it might be three or four. Knowing that all thirty-second equivalents have five places, if the third figure in this case were four, the final two figures would not follow in the sequence, as explained by the foregoing rule; but if the third figure is 3, then the rule is complied with and the last three figures are 375, making the decimal 0.59375.

To obtain results in sixty-fourths, it is necessary to follow the first rule concerning the three figures and to know another preceding figure, which may be memorized or not. The ending sequence run as follows:

0625	5625
1875	6875
3125	8125
4375	9375

To find 37/64, read the result on the slide rule, it being 0.57+, the third figure appearing so close to 8 that we must conclude from the table that the end to be supplied is 8,125, hence the complete decimal 0.578125. If you do not remember the figures of the table here given, all you have to do is to find the equivalents of the sixteenths by reading from the slide rule, the same as in the first case. It will be noticed that the sequence of four figures given correspond to the decimal equivalents of the sixteenths, as 13/16 = 0.8125. The equivalent of 41/64 would appear on the slide rule to be 0.64, but by following the method given the result will be 0.640625.

Another very useful application of the slide rule to decimal equivalents is the inverse of the usual procedure. Suppose a calculation has been made for a shaft of a certain diameter, the final result being a decimal. The nearest size in sixteenths of an inch is usually desired. Setting the index of the slide to the decimal given, the numerator of the fraction can be read under 16. If the decimal of the calculation is 0.67, the result opposite 16 on the slide rule is approximately 10.7, the nearest integer being 11, so that 11/16 would be the fraction used. Or, if it is desired to get the closest result down to a sixty-fourth, the result, read under 64 on the slide, would then be 43/64.

Standard Catalogs from the Engineer's Point of View

BY C. V. LOVELL

At the catalog conference of the National Association of Purchasing Agents, held in Chicago on May 22, 1918, a recommendation was made that all catalogs meant for the use of purchasing agents be made a certain size. Strange to say, after over two years have elapsed, we find comparatively few manufacturers adopting the size recommended (7½ x 10⅝ in.). The reason for this is quite clear; the size is too large.

According to the report issued by the association 79½ per cent of the catalogs examined by the Standardization Committee had a page size of 6 x 9 in. or smaller. Granting that the majority of manufacturers prefer a catalog of the smaller size, what size does the engineer prefer? I wonder if the man responsible for catalogs ever considers the fact that to a very large extent the purchasing agent must get his specifications from the engineer.

Let us consider one of the existing standards: The S. A. E. data sheet is perhaps the most widely known of existing engineering standards. (The writer is not a member of the S. A. E. and, therefore, he has no mercenary motives). Naturally this standard is being adopted by manufacturers of parts used in automobile construction. (Ball bearing manufacturers for instance.) Consequently, designers of special machinery and tools used in automotive work follow suit and use the same standard for the collection of data and much prefer this size (4½ x 7½ in.) for catalogs.

Imagine the convenience to the designer, who is after all the man who buys the goods in question, if he could select all of the material used in the construction of the machines or tools he is making from a loose-leaf book containing catalog sheets of the various material such as steel, bolts, screws, oiling devices, shafting, gearing, clutches, couplings, pipe fittings, keys, cotters, lock washers, etc. If these catalogs were published in loose-leaf form, the engineer could select the sheets most frequently used from the several catalogs and place them in his hand-book and file the remainder for future reference. Another advantage of the loose-leaf catalog is that standard goods would not have to be cataloged every year, but could be taken care of by issuing new price sheets, thus reducing advertising costs to a considerable extent.

The writer does not advocate making all catalogs to this standard, but does believe that there is a very large field especially in stock sheets which could be covered very satisfactorily by a 4½ x 7½ loose-leaf catalog.

SPARKS FROM THE WOR

Valentine Francis

Program of the American Foundrymen's Association Convention Announced

The annual convention of the American Foundrymen's Association will be held in Columbus, Ohio, Oct. 4 to 8. It has been announced that there will be over two hundred companies exhibiting at the convention and that there will be seven buildings to house this large number of exhibitions.

The technical and industrial relations sessions of the convention are very attractive; among the papers to be read at these sessions are the following:

"Foundry Methods and Equipment for Producing Machine Tool Castings," by A. N. Kelley, Cincinnati, Ohio.

"Electrical Apparatus in a Modern Iron Foundry," by F. D. Eagan, Westinghouse Electric Manufacturing Co., East Pittsburgh, Pa.

"Report of Committee on General Specifications for Gray Iron Castings to Co-operate with A. S. T. M.," by Richard Moldenke, chairman, Watchung, N. J.

"Recent Developments in Die Casting," by Charles Pack, Doehler Die Casting Co., Brooklyn, N. Y.

"Heat Treatment of Steel Tractor Castings," by Fred Grotts, Holt Manufacturing Co., Peoria, Ill.

"Electric Steel Making," by James W. Galvin, Ohio Steel Foundry Co., Springfield, Ohio.

"Training Foundry Executives," by R. E. Kennedy and Bruce W. Benedict, Shop Laboratories, University of Illinois, Urbana, Ill.

"The Right Man on the Right Job," by Arthur H. Young, manager, Industrial Relation, International Harvester Co., Chicago, Ill.

"The Triplex Process of Making Malleable Iron," by H. A. Schwartz, National Malleable Castings Co., Indianapolis, Ind.

"Important Considerations in the Design of Modern Foundries," by J. H. Hopp, Chas. C. Kawin Co., Chicago, Ill.

"Arc Welding Machines for the Foundry," by A. M. Candy, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

A business meeting will be held on Oct. 7, and on Oct. 7 and 8 there will be general sessions.

1920 New York Electrical Show

The 1920 New York Electrical Show will be held at the Grand Central Palace from Oct. 6 to 16. A record variety of exhibits has been arranged for, representing a forty-eight per cent increase over the 1919 show, and three floors of the big Palace will be filled with displays and demonstrations of a thousand and one uses of electricity. The number of exhibits will be 141, representing as many individual manufacturers.

This year the entire third floor of the Palace has been given over to a series of working exhibits where the employment of electricity in a score of industries will be demonstrated. One will be material handling, with industrial trucks, conveyors and hoists all in operation. The Material Handling Machinery Manufacturers' Association and the Electric Hoist Manufacturers' Association are co-operating with different makers in this particular exhibit. Among the processes of manufacture to be seen in actual operation are welding, japanning, heat treating, rivet heating, oil tempering and heating with vacuum furnaces. Three types of machine shops will be operated and there will be a special exhibit showing factory lighting.

Am I an American?

THE time has come when every citizen of this Nation should halt in his daily doings and, searching his soul, ask himself the question: "Am I an American? In my actions, am I squaring myself with the great American principles of Liberty, Justice and Equality, which have been the great constructive forces for the advancement and uplift of Humanity?"

The man who would subject the national life and all of its interest to the will of his group is an unrighteous and a disloyal citizen. He is unrighteous because he would substitute selfish aggrandizement for fixed principles of justice. He is disloyal because he denies his allegiance to his country and gives it to the particular class to which he belongs and beyond which his narrow vision and perverted purpose do not reach.

Americanism cannot live—this Nation as conceived by our fathers, cannot endure under the shackles of class control. When the laws are defied and mob violence resorted to, we must meet it with force and see to it that life and property are protected.—Governor Goodrich of Indiana.

Detroit a Progressive City—Other Cities Will Do Well To Follow Her Lead

The City of Detroit, determined to maintain its lead as a progressive aeronautical center, intends establishing its second municipal landing field in the heart of the city.

At the request of the Commissioner of Parks and Boulevards, the commanding officer of Selfridge Field, Captain N. J. Boots, flew over the proposed site and after making an additional ground inspection will recommend its establishment at the next meeting of the city council.

The field will only permit one-way landings to be made, but in the event of a strong south wind the other municipal field, located several miles away, will be available. The new field is situated along the Detroit River, very close to the heart of the city, and its water frontage makes it peculiarly adaptable for use by seaplanes. In fact, it is already being used by the United Aerial Express Co. as a home base for its seaplane flying between Detroit and Cleveland.

The commanding officer has conferred with the officials of the City of Detroit relative to the framing of an ordinance governing flying over that city. The opinions of the Chief of Air Service in this matter were given and the city authorities agreed that legislation governing aerial traffic should be enacted by the Federal Government, in order that such regulations will be universal throughout the country. They realize that haphazard legislation by separate municipalities will only result in a confusing tangle of laws. This matter is being held in abeyance for the time being.

Machinery Club of Chicago Plans Great Picnic

On Saturday of this week the Machinery Club of Chicago will hold its annual picnic at Thatcher's Woods, River Forest, Chicago. Judging from the advanced notices and the varied program arranged by the committee in charge, this will be one of the banner events in the history of the organization.

A feature of the outing will be the fried chicken lunches, put up in boxes along with the other "fixin's," which will be distributed at the grove. Races for the ladies as well as the men, a ball game between Ray Jone's "Pathfinders," and Peterson's "Ramblers," and special attractions for the kiddies will help fill up the remainder of the day's sport.

LD'S INDUSTRIAL FORGE
News Editor

Iron and Steel Electrical Engineers Hold Week's Convention at New York

For five days last week the spacious roof of the Hotel Pennsylvania in New York was the scene of the fourteenth annual convention of the Association of Iron and Steel Electrical Engineers.

One side of the garden was set aside for the convention session, while the other was turned into a veritable maze of motors, transformers, lighting fixtures, and mechanical and electrical apparatus of every description. The exhibit was one of the finest ever produced by the association.

The convention opened Monday with reports of committees, after which the election of officers took place. The balloting resulted in the following selections for the ensuing year: E. S. Jeffries, president; W. S. Hall 1st vice president; C. E.Bedell, 2nd vice president; James Farrington, treasurer; John F. Kelly, secretary. Directors elected were: Gordon Fox, F. E. Galbraith, S. L. Henderson and W. C. Suppler.

After these perfunctory numbers the convention settled down to the regular routine. The papers presented were varied and were all of great technical value. Some of these papers were:

"Practical Education of Steel Mill Electricians," by B. A. Cornwell; "Relation of Standardization in Electrical Equipment to Safety," by Walter Greenwood; "Power Transmission for Industrial Plants," by D. M. Petty; "Underground Transmission," by A. L. Freret; "Some Consideration in the Determination of Auxiliary Drives," by Gordon Fox; "Report of Electrical Development Committee for 1920," by E. S. Jeffries (chairman); "The Reversing Electric Mill Considered From the Standpoint of Tonnage," by K. A. Pauly; "Some Economic Considerations in Design of Power Plants for Steel Mills," by T. E. Keating; "Current Limit Reactance," by R. H. Keil; "Report of Electric Furnace Committee for 1920," by E. T. Moore (chairman); "Standardization Committee Report," by W. T. Snyder (chairman).

On Monday night the members of the association were treated to a first-class vaudeville show which was produced through the courtesy of the McGraw-Hill Publishing Co., of New York. The show was followed by a cotillion in which the conveners and their friends joined in the merry making till the wee hours of the mourning.

The convention adjourned Tuesday afternoon while the members enjoyed a sail up the Hudson to Bear Mountain, as the guests of the United States Steel Corporation. The annual banquet was held Wednesday night and was attended by over 1,000 persons.

The Convention Committee included: A. H. Swartz, chairman, J. H. Adkins, F. A. Annett, G. M. Baker, J. O. Corbett, J. F. Kelly, B. G. Kodjbanoff, T. B. Montgomery, H. D. Rei, A. R. Ross, T. A. Tate, F. Tresselt, R. G. Widdows.

What the Open-Shop Plan of Employment Means to the American People

IT IS a mistaken idea that the open-shop method of conducting industrial relations is a technical phase of industrialism of interest and benefit only to the employer and the employee.

The effect of the open shop, which means, in a word, the right of every man to earn a living for himself and his family regardless of his political, religious or labor affiliations, extends through every ramification of a nation's life.

The open-shop plan of employment directly influences production, as under the open shop there can be no restriction of output.

The open-shop plan of employment removes the possibility of frequent strikes, with resultant suffering, violence, loss of savings and national disturbance.

The open-shop plan of employment, *open to both union and non-union men*, makes possible the promise that "the laborer is worthy of his hire," and in its results spells prosperity for nation, family and individual.—From *Industry*.

Appointed Navy Department Sales Advisor

V. C. Kylberg has been appointed sales advisor to the Navy Department. During the period of greatest activity in the disposal of the War Department's surplus property, Mr. Kylberg was assistant chief of the machine-tool section of the Office of the Director of Sales.

Later he organized the Procurement Division for the Army's vocational training schools. More recently he has been acting head of the sales section of the U. S. Shipping Board.

Jones-Reavis Bill Indorsed by National Machine Tool Builders

The National Machine Tool Builders' Association has indorsed the work of the National Public Works Department Association as outlined in the Jones-Reavis bill, and is giving its moral and financial support to the plan to reorganize the Department of the Interior, according to a statement from Charles E. Hildreth, general manager of the association, given out by M. O. Leighton, national chairman of the National Public Works Department Association.

The resolution passed by the National Machine Tool Builders' Association, at its annual convention, endorses the Jones-Reavis bill as a measure "purporting to correlate the departments of the Government having to do with public emergency matters which would not create new Government departments but would rather eliminate the duplication of work now performed by many departments. A further object of the bill is a material reduction in Government expenditures for public works."

The public works movement has been endorsed by Senator Harding, Governor Cox, Ex-Secretary Lane, General Wood, Herbert Hoover, Governor Coolidge, Hugh Frayne, Samuel Gompers, Franklin D. Roosevelt and many governors, bankers and engineering societies throughout the country. It is expected that the next Congress will take definite action on the Jones Reavis bill.

McCrosky Tool Corporation Outing

The annual field day and picnic of the McCrosky Tool Corporation, Meadville, Pa., was held this year at Conneaut Lake Park, Pa. A fair, cool day favored the outing, and consequently the field events were all vigorously contested. A baseball game, in which the McCrosky team of the Meadville Industrial League was divided between the opposing nines, formed the climax of the athletic program. Dinner was served at the Oakland Hotel and was followed by a list of snappy toasts. Boating, swimming, and the amusements at Conneaut Lake Park completed a most successful day.

The International Machinists' Association has protested to the President against Secretary Baker's "shop organization" plan.

Annual Convention of the International Railway General Foremen's Association

The annual convention conducted by the Railway General Foremen's Association was held in the Hotel Sherman, Chicago, from Sept. 9 to 10, 1920. The officers in charge of the meeting were president, W. T. Gale, C. & N. W. Ry., Chicago; secretary, William Hall, C. & N. W. Ry., Winona, Minn. Prepared addresses were presented on previously assigned topics, including, "Standardization of Engine Failures and Terminal Delays," "The Best Methods of Repairing Superheater Units," and "How to Reduce the Cost of Repairs in Locomotive and Car Departments."

The officers elected for the following year are: president, J. B. Wright, general foreman, H. V. Ry., Columbus, Ohio; first vice president, Geo. H. Logan, C. & N. W. Ry., Chicago, Ill.; second vice president, H. E. Warner, N. Y. C. Ry., Elkhart, Ind.; secretary-treasurer, William Hall, C. & N. W. Ry., Winona, Minn.

An elaborate exhibition of tools and specialties for locomotive and car construction had been arranged by the Association of Railway Supply Men. This occupied all available space in the lobbies and halls of two floors of the hotel, and was attended with marked interest by the visitors. Officers in charge of the Supply Men included, chairman, H. A. Varney, Sunbeam Electric Manufacturing Co., Chicago; and secretary-treasurer, Clarence L. Mellor, Barco Manufacturing Co., Chicago.

Belgium Honors Colonel LaMar

In recognition of the assistance extended the Belgian Government and Belgian industries, the King of the Belgians has named Colonel Alfred LaMar an officer of the Order of Leopold II. The insignia of the order was presented to Colonel LaMar on the occasion of his recent visit to Belgium. E. C. Morse, the Director of Sales, and others of his lieutenants will be decorated at the earliest opportunity.

Colonel LaMar was in immediate charge of the negotations between the War Department and the Belgian Government, in arranging for the sale of surplus machine tools. He has just returned to his desk after having looked carefully into the machine-tool situation in Belgium. Just as soon as the exchange situation is restored to anything like normal, he predicts that a large number of orders for machine tools will be placed in this country. There is a great shortage of tools, he said, but everyone is trying to get along with the minimum amount of equipment until the present prohibitive rate of exchange is overcome. Any manufacturer of machine tools who desires to extend a long-time credit will be able to do a great deal of business in Belgium even at this time, Colonel LaMar declares.

Colonel LaMar was in Belgium a year ago. He expresses astonishment at the progress which has been made in that country during the period between his visits. He finds that the Belgian manufacturers and machine-shop men are very grateful for the assistance which they received from America. The fact that they were able to obtain American-made machine tools has been the most important single factor enabling these activities to reconstruct so rapidly.

A bas-relief map of the world has been made at the naval gun factory at the Washington Navy Yard for use at the marine exposition which is to held in Chicago. The map is fashioned from aluminum plates. In its completed form it is 42 feet long and 15 feet wide.

Business Items

The Delion Tire and Rubber Co., Trenton, N. J., has bought the plant and equipment of the Dreadnaught Tire and Rubber Co., Orangeville, Baltimore, Md. The company will install additional machinery. J. W. Price is the president.

At a meeting of the stockholders of the Plymouth Motor and Machine Co., Plymouth, Wis., it was voted to change the firm's name to the Plymouth Metal Products Co. It also will increase its capital from $60,000 to $100,000. The officers of the new concern are: president, George W. Brickbauer; vice president, L. E. Schwab; secretary and treasurer, (Miss) Martha Merget.

A. F. Way & Co., Inc., Hartford, Conn., has just completed its new factory in East Hartford. This is much larger than its present plant and will give this company increased facilities for the building of special machinery, tools, etc., on contract, as well as manufacturing its line of utility size blocks, sine bars, stock supports and machines.

The O. R. Adams Manufacturing Co., Inc., of Rochester, N. Y., has been taken over by the Seneca Falls Manufacturing Co., Seneca Falls, N. Y. This firm will continue to manufacture the Adams Short-Cut Lathe. Ogden R. Adams is severing his connection with the Short-Cut Lathe business, and will give his entire time and interests to his regular machine-tool business at the St. Paul St. store.

The Gilbert & Bennett Manufacturing Co., Georgetown, Conn., manufacturer of wire and wire goods, etc., will erect a large recreation building at its plant for the use of employees. The building will be of brick and steel construction, two stories high and 40 x 60, and will contain a large restaurant, recreational features, etc.

The Crofoot Gear Works, Inc., has announced the opening of its new factory in the Hyde Park section of Boston, Mass.

Personals

C. A. WILLARD, formerly with the M. S. Wright Co., Worcester, Mass., in the capacity of plant engineer, has taken up new duties in charge of the research work for the Bridgeport, Conn., Chamber of Commerce.

COLONEL PAUL R. HAWKINS has been appointed district manager of the Pittsburgh office of the Norton Co., grinding machinery manufacturer, of Worcester, Mass.

DR. E. F. NORTHRUP has resigned his professorship at Princeton University in order to devote his entire time to his work with the Ajax Electrothermic Corporation, Trenton, N. J., manufacturer of the Ajax-Northrup high frequency induction furnaces. Dr. Northrup has recently been elected vice president of this company and is now engaged in perfecting for them a brass-melting furnace of this Ajax-Northrup type.

JAMES DELLAGE, of the Hart-Parr Co., Charles City, Ia., has gone to England to take charge of the Hart-Parr tractor at the Lincoln trials. He will then go to France to be in attendance at the French semi-annual trials.

J. H. KREIDLER, for several years an executive in various automobile plants, has joined the sales organization of the J. R. Stone Tool and Supply Co., Detroit, Mich.

L. W. HARSTON, who has been with the sales department of the Elyria Iron and Steel Co., of Cleveland, Ohio, for the past three years, has succeeded F. R. Guyon as assistant manager of sales.

Forthcoming Meetings

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

The 1920 New York Electrical Show will be held in the Grand Central Palace from Oct. 6 to 10.

The Standardization Conference of the National Association of Purchasing Agents will be held at the Congress Hotel, Chicago, Ill., on Oct. 9.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The Federated American Engineering Societies will hold its first meeting at the Hotel New Willard, Washington, D. C., on Nov. 18 to 20 inclusive.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

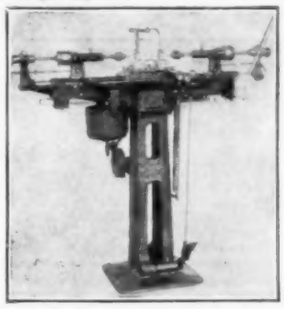
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Countersinking Machine, Opposed-Spindle

Langelier Manufacturing Co., Arlington, Cranston, R. I.

"American Machinist," Sept. 9, 1920

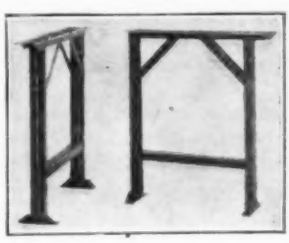


This machine is intended for countersinking or centering both ends of pins simultaneously. Pins from 1½ to 4½ in. long and ⅛ to ½ in. in diameter can be handled; production, eight pins per minute. Each drilling head contains a hardened spindle running in phosphor-bronze bearings; drilling speed, 2,000 r.p.m. Each spindle carries a No. 2A Jacobs chuck having a maximum capacity of ⅜ in. The spindles can be fed simultaneously by a hand lever, which acts through racks and a pinion. The feeding yokes are so attached to the spindles by clamps that the position of the tools may be adjusted to suit the work. The depth of the feed is controlled by means of adjustable stops. The work-holding fixture is adjustable for different sizes of work, the pins to be countersunk being held between beveled bushings in the two jig-heads.

Bench Legs, Steel

Angle Steel Stool Co., Otsego, Mich.

"American Machinist," Sept. 9, 1920

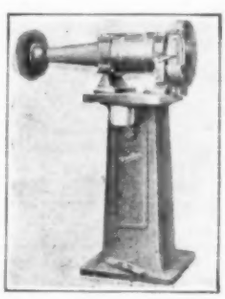


These steel legs are made in various heights and styles, style 5-26 being shown in the illustration. The tops of the legs are flat, so that boards of any width may be laid on them. If desired, heavy planks can be used along the front edge with light ones in the rear where the wear is less severe. The top member and shelf support are furnished with from three to five holes for bolting on the planks. To form a wider table two legs may be used back to back. All legs are finished with a baked-on green enamel.

Grinding and Buffing Machines, Heavy-Duty

Van Dorn Electric Tool Co., Cleveland, Ohio.

"American Machinist," Sept. 16, 1920

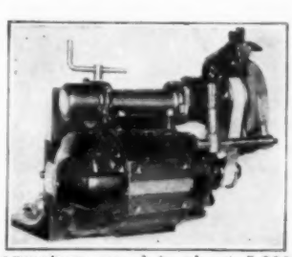


The 1-hp. heavy-duty electric grinding machine shown is of the floor type. The motor is built to A. I. E. E. standards and has a momentary overload capacity of 2½ hp. An a.c. stator and a d.c. field assembly are made interchangeable in the motor frame. Specifications: Height of spindle, 39 in. Base, 17 x 18 in. Spindle diameter at wheel, ¾ in. Weight of machine with one guarded wheel and one extension, as shown; net, 345 lb.; crated, 450 lb.; boxed for export, 500 lb. Contents export box, 21 cu.ft. Arrangement is made for attaching exhaust system, and extensions for carrying brushes or wheels can be furnished. Bench and aerial types of this machine are also manufactured.

Grinding Machine, Portable, Electric

Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill.

"American Machinist," Sept. 16, 1920

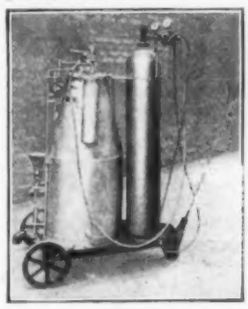


The machine shown is known as type 2UA. Interchangeability of the pulleys permits its use either for internal grinding with a high-speed spindle or external grinding, with slower speed and larger wheel. The wheel can be carried on an extension of the armature shaft. Slides are provided for vertical and horizontal adjustments. The motor body has flats finished on its outside faces, so that the spindle may be shifted. Spindle extensions 5, 10 or 15 in. long may be attached for internal grinding. The armature speed is about 5,200 r.p.m. A 5½- to 6- in. wheel can be used when operating at the slower speed. The motor is about ¼ hp., and the total weight of the tool, without equipment, is 25 lb.

Generator, Acetylene, Automatic

Imperial Brass Manufacturing Co., 1200 West Harrison St. Chicago, Ill.

"American Machinist," Sept. 9, 1920

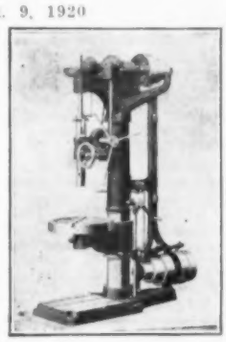


This generator is intended for use in oxy-acetylene welding, cutting and lead burning. It is of the medium-pressure, carbide-to-water type. The pressure in the generator is controlled by a spring in a diaphragm governor, which, operating in conjunction with the automatic feed, maintains a uniform pressure. No acetylene regulator is required in the service line unless a number of torches are being fed from it. A 15-lb. per-square-inch blowoff is provided. The levers for operating are interlocked so that it is necessary to follow the proper sequence of operations. It will run for five hours on one filling of carbide. It is made in four sizes; carbide capacities, 15, 25, 50 and 100 lb. respectively. Generating capacities respectively, 15, 25, 50 and 100 cu.ft. of gas per hour. The largest size will supply eight torches on medium-duty. Weights, from 140 to 350 lb.

Drilling Machines, Stationary-Head, 24-, 26- and 28-In.

Sibley Machine Co., South Bend, Ind.

"American Machinist," Sept. 9, 1920



These machines are intended for production work. Specifications: Height, top of cone pulley, 86 in. Spindle to base, maximum, 44½ in. Spindle to table, maximum 27½ in. Traverse of table, 13 in. Travel of spindle, 12 in. Feed per rev. of spindle, 0.006, 0.010, 0.015 and 0.020 in. for 24-in. machine; 0.008, 0.012, 0.016 and 0.024 in. for 26- and 28-in. machines. Diameter of table, 21, 23 and 25 in. for 24-, 26- and 28-in. machines, respectively. Diameter of columns, 8 in. Hole in spindle, No. 4 Morse taper. Ratio of back gears, 4½ to 1. Speed of countershaft, 500 r.p.m. Spindle speeds, 29 to 495 r.p.m. for 24-in. machine; 26 to 403 r.p.m. for 26- and 28-in. machines. Floor space, 23 x 63 in. Weight; net, 1,600 lb. for 24-in. machine, 1,650 lb. for 26-in., and 1,700 lb. for 28-in.; boxed for export, 2,000, 2,050 and 2,100 lb., respectively. Size, boxed for export, 76 cu.ft.

Gages, Combination, Blocks, Reference

Van Keuren Co., 362 Cambridge St., Allston, Boston, Mass.

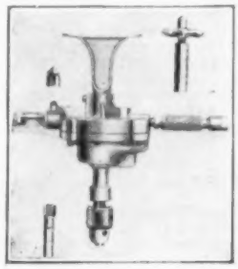
"American Machinist," Sept. 16, 1920

These sets of combination precision-gage blocks are intended as reference standards. It is said that the gages are made cylindrical to give the proper distribution of metal, so that temperature changes will affect the blocks uniformly. The gaging surfaces are lapped to a mirror finish, and the blocks are guaranteed to be correct in size, flatness and parallelism within 0.00001 in. of the nominal marked dimensions. The gages are standardized by light-wave measurement with standards certified by the National Bureau of Standards, and are arranged in various sets to meet the requirements of both large manufacturing concerns and individual mechanics. The set shown contains five sizes in the binary fractions of an inch; namley, 1, ½, ¼, ⅛ and 1/16 in.

Drilling Machine, Pneumatic, Portable

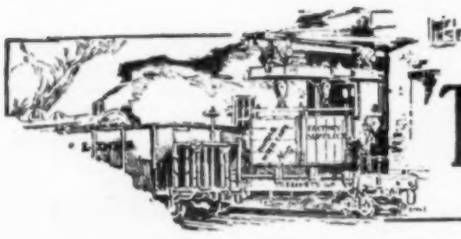
Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio.

"American Machinist," Sept. 16, 1920



The machine operates on the turbine principle; it will drill holes up to ¼ in. in diameter in steel, and bore holes up to 1 in. in diameter in wood. It can be furnished with a screw feed, top point, breast plate and spade grip which are detachable and interchangeable, also screw chucks and No. 1 Morse taper socket. The housing and the turbine are made of aluminum, while nickel steel gears and vanadium steel pinions are employed. The weight is 9 lb. The air consumption is given as 20 cu.ft. per minute. The drill will operate on a pressure of 60 lb. per square inch, although maximum efficiency is obtained at 100 lb. The speed is controlled by a valve on the inlet.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$45.60	$30.35
Northern Basic	51.30	27.55
Southern Ohio No. 2	47.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	54.30	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	36.20
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	50.00	29.00-30.00
Virginia No. 2	50.00*	33.10
Basic	48.00†	26.75
Grey Forge	45.00*	26.75
CHICAGO		
No. 2 Foundry local	46.40	26.75
No. 2 Foundry, Southern	48.60	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	49.00	28.15
Basic	48.50	27.15
Bessemer	50.00	29.35
MONTREAL		
Silicon 2.25 to 2.75%.	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.58	$4.47	$3.47	$5.00	$3.37	$4.08	$3.47
Soft steel bars	4.73	4.62	3.37	4.50	3.27	3.98	3.37
Soft steel bar shapes	4.73	4.62	3.37	.....	3.27	3.98	3.37
Soft steel bands	6.43	6.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.78	4.67	3.67	4.50	3.57	4.28	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.23@8.00	5.50	8.10	7.90
No. 12	3.60-7.05	7.28@8.05	5.40	8.15	7.95
No. 14	3.65-7.10	7.33@8.10	5.35	8.20	8.00
No. 16	3.75-7.20	7.43@8.20	5.30	8.30	8.10
Black					
Nos. 18 and 20	4.20-6.20	8.41@9.80	4.77	8.70	7.13
Nos. 22 and 24	4.25-6.25	8.46@9.85	4.67	8.75	7.18
No. 26	4.30-6.30	8.51@9.90	4.57	8.80	7.23
No. 28	4.35-6.35	8.61@10.00	6.75	8.90	7.33
Galvanized					
No. 10	4.70-8.00	8.91@11.50	6.45	9.00	8.25
No. 12	4.80-8.10	9.01@11.50	6.30	9.10	8.30
No. 14	4.80-8.10	9.01@11.60	6.30	9.10	8.45
Nos. 18 and 20	5.10-8.40	9.26@11.90	6.60	9.40	8.75
Nos. 22 and 24	5.25-8.55	9.41@12.05	6.75	9.55	9.15
No. 26	5.40-8.70	9.56@12.20	6.90	9.70	9.30
No. 28	5.70-9.00	9.86@12.50	7.20	10.00	9.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.36	$5.90	$6.00
Flats, square and hexagons, per 100 lb. base	6.86	6.40	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Base prices in cents per pound F.O.B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots			42
Malleable nickel sheet bars			47
Hot rolled rods, Grades "A" and "C" (base)			60
Cold drawn rods, grades "A" and "C" (base)			72
Copper nickel ingots			45
Hot rolled copper nickel rods (base)			54
Manganese nickel hot rolled (base) rods "D" — low manganese			62
Manganese nickel hot rolled (base) rods "D"— high manganese			67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f.o.b. New York: 1/16, 8½c. per lb.; ⅛, 8c.; 3/16 to ¼, 7½c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per poundare from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.15
Spring steel (light)	10.00	11.00	12.50
Coppered bessemer rods	9.00	8.00	6.86
Hoop steel	6.68	6.50	5.43
Cold-rolled strip steel	12.50	8.25	11.00
Floor plates	6.91	6.00	6.88

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
¼ to 3	54–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1	24½–34½%	8 –18½%
LAP WELD					
2	47 –50½%	34½–38%	1¼	.....	.....
2½ to 6	50 –53½%	37½–41%	1½	.....	.....
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %	.....	2½ to 6	22½–30½%	9½–17½%
15	35 –38½%	.....	7 to 12	19½–27½%	6½–14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
¼ to 1¼	52 –55½%	39½–43%	¼ to 1	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 –48½%	33½–37%	1¼	.....	.....
2½ to 4	48 –51½%	36½–40%	1½	.....	.....
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
¼ to 3 in. steel butt welded	38%	22%	39%	30%	54%-40%	40½@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18.50	19.00	22.50
Tin in 5-ton lots	44.50	49.00	56.50
Lead	8.50	9.50	6.25
Zinc	8.50	8.35	7.60
ST. LOUIS			
Lead	8.00	8.90	6.00
Zinc	7.70@8.05	7.70@8.40	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

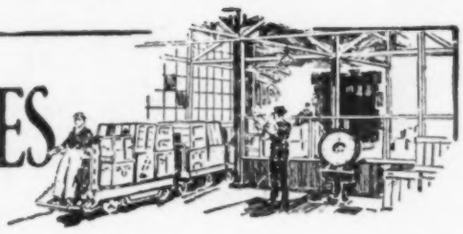
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	29.50	33.50	33.50	34.00	35.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	30.75	29.00	30.50	29.00	25.00
Brass sheets	28.50	28.50	32.00	36.00	33.00	27.00	28.00
Brass pipe	33.00	33.00	36.00	34.00	39.00	34.00	37.00
Solder (half and half) (case lots)	35.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	24.00
New York	27.00	28.00@29.75
Cleveland	27.00	29.00
Chicago	30.00	27.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill + less 8% for carload lots..... 12.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	12.50	14.70	13.00
New York	14.00	11.50	14.50	12.50
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.25	9.50
Chicago	9.00	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	15.00	17.00	14.00	15.00
Copper, heavy, and wire	14.00	16.00	13.50	14.50
Copper, light, and bottoms	12.50	14.00	12.00	13.00
Lead, heavy	7.00	4.75	7.00	7.00
Lead, tea	5.00	3.75	4.00	6.00
Brass, heavy	9.50	10.50	10.00	14.50
Brass, light	7.00	7.50	7.00	8.00
No. 1 yellow brass turnings	8.50	10.00	7.50	8.00
Zinc	5.00	5.00	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$33.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	33.00
Chicago	29.00	31.00
Cleveland	34.00	35.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	54.00	70.00	60.00	60.00
Commercial	50.00	50.50	20.50	16.50	15.00	13.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	—New York—		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$1.50	List net	$2.25	+1.15	1.85
Hot pressed hexagon	+ 6.00	1.50	List net	2.25	+1.15	1.85
Cold punched hexagon	+ 6.00	1.50	List net	2.25	+1.15	1.30
Cold punched square	+ 6.00	1.50	List net	2.25	+1.15	1.30

Semi-finished nuts, ⅜ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50-10%
Chicago	40%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	25%	20%
Larger and longer up to 1½ in. by 30 in.	+ 20%	25%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... list Cleveland..... $2.00 Chicago..... $1.90

For cast-iron washers, ½ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	25%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.73 Pittsburgh..... $4.5

Structural, same sizes:
New York..... $7.10 Chicago..... $5.83 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$34.00	$36.00	$35.00
Brass	33.00	36.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add 15-20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	3.00	2.75
Chicago	2.00	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	September 27	September 20	September 13
Prompt furnace	$17.00@$18.00	$17.00@$18.00	$17.00@$18.00
Prompt foundry	18.00@20.00	18.00@20.00	18.00@20.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

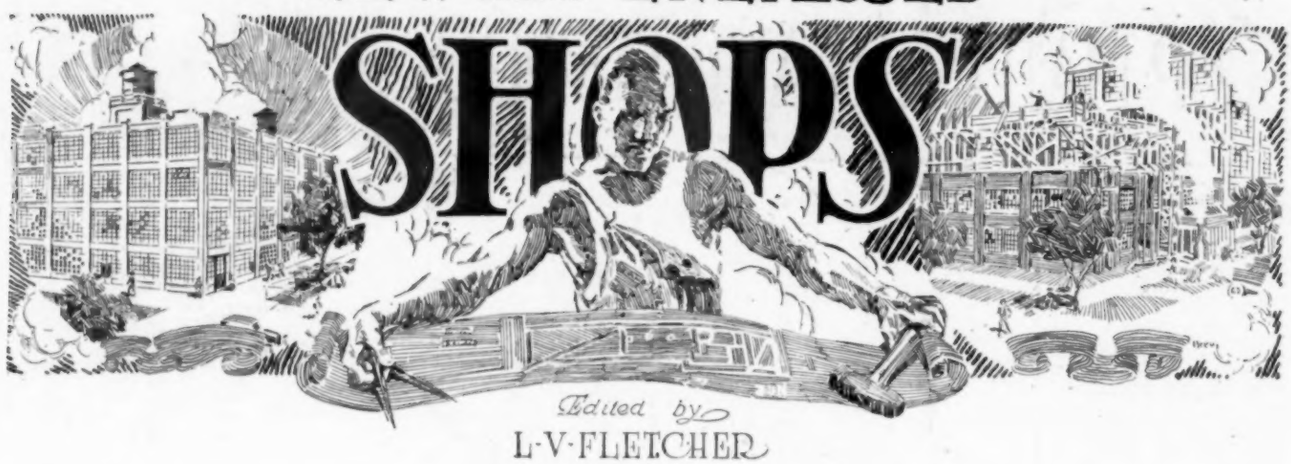
	—New York—		—Cleveland—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots)	$1.25	$2.15	$1.55	$2.50	$1.40	$2.37
5-gal cans	1.40	2.30	1.75	2.75	1.65	2.57
1-gal cans (6 to case)	1.45	.....	.....	.....	.....	.....

WHITE AND RED LEAD—Base price per pound:

	— Red —				— White —	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10-2½% discount.

NEW *and* ENLARGED SHOPS



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., West Hartford (Hartford P. O.)—The Hartford Tube Products Co., Elmwood Ave.—punch press, ⅜ in capacity, 4 in. pipe machinery and shears, ⅜ in. capacity.

Md., Baltimore—The Supt. of Lighthouses—3 step cone double back geared engine lathes for machine shop.

N. Y., New York (Borough of Manhattan)—The Amer. Book Bindery, 406 West 31st St.—one Cleveland drill.

N. Y., New York (Borough of Manhattan)—The Amer. Brake Shoe and Fdry. Co., 30 Church St.—punches, drill presses, engine lathe, boring machine and riveting machine.

N. Y., Buffalo—The Buffalo Fdry. & Machine Co., 1543 Fillmore Ave.—miscellaneous equipment for pattern shop.

N. Y., Buffalo—The Martin Sheet Metal Wks., 878 Hertel Ave.—one stove pipe folder.

N. Y., Buffalo—L. Michael & Co., 560 Elk St.—acetylene cutter.

N. Y., Buffalo—The Pengot Co. of Amer., Colgate and Hopkins Sts., D. W. Healy, Iroquois Hotel, Purch. Agt.—equipment for automobile plant.

N. Y., Rochester—The Alent Machine Tool Co., 479 St. Paul St., N. Alent, Mgr.—one 8 ft. planer.

N. Y., Rochester—The Harrison Machine Co., 144 and 146 Platt St., J. Harrison, Purch. Agt.—one 42 in. lathe and one 16 in. lathe.

N. Y., Rochester—The Hauser Machine Co., 245 Mill St., L. Hauser, Purch. Agt.—one 32 in. lathe.

N. Y., Rochester—G. C. Humbert, 301-303 Cornwall Bldg., manufacturer of jewelry—die sinker's tool with flexible shaft, controlled by hand.

N. Y., Rochester—The Kneeland Co., Inc., Lincoln Park, L. W. Kneeland, Purch. Agt.—medium size brazing machine.

N. Y., Summerville—S. Ban, Stop 26—small power lathe.

N. Y., Syracuse—The Bd. of Educ., c/o Bd. Contract and Supply—complete equipment for machine shop at Continuation School, including engine lathes, milling machines, shapers, bench grinders and bench tools. About $5,000 available for above equipment. No date set for close of bids.

N. Y., Utica—The Eureka Mower Co., 1005 Hickory St.—one 18 in lathe.

Pa., Bradford—The Cyclone Brush Co., 106 Elm St.—various screw machines.

Pa., Philadelphia—Morton & Murphy, 841 South 51st St.—bench lathe.

Pa., Philadelphia—The Tioga Iron and Steel Co., 52d and Gray Sts.—machine tools.

Pa., Pittsburgh—The National Casket Co., Reedsdale St.—miscellaneous machine tools.

Pa., Williamsport—J. A. Shoemaker, Chn. Supply Com., Williamsport School Bd.—
One 26 in. x 26 in. x 8 ft. electric driven planer.
One 16 in. shaper.
One No. 2 electric driven universal milling machine.
One 24 in. electric driven drill press.
One 1 ton portable crane.
One No. 4 Arbor press.
One 15 hp. motor.
Miscellaneous equipment, including hangers, line shafting, pulleys, chucks and small tools for machine shop.

Va., Richmond—P. H. Blaska, 908 Louisanna St.—small speed lathe.

Va., Richmond—J. E. Childress, 306 Louisanna St.—cornice machine.

Va., Richmond—A. S. Kellam, 18 East Broad St.—small machine lathe (new or used).

Va., Richmond—The Kersey & Co., Williamsburg Ave. and Denney Sts.—mechanical outfit for repairing automobiles.

Va., Richmond—G. B. Mrock, R. F. D. No. 5—18 to 24 in. lathe, short bed preferred (new or used).

Va., Richmond—Viaduct Motor Co., J. S. Savage, Purch. Agt.—tire rim stretcher and gear press.

Va., Richmond—L. M. Walton, 514 Louisanna St.—mechanical outfit for repairing automobiles.

Ill., Chicago—The Ford Roofing Products Co., 520 Conway Bldg.—one lathe, 16 in. center to center, 36 in. swing roll clear of tool carriage.

Ill., Chicago—The Illinois Felt Co., 2501 West 48th St.—machine tool equipment for making automobile seats.

Ill., Chicago—The Parisian Novelty Co., 151 West 22d St.—squaring shear 36 in. for 18 in. gage.

Ill., Chicago—The Unity Equipment Co., 127 North Dearborn St.—double head bolt threader for ⅝ and ¾ in. bolts.

Ill., Mendota—Black Bros. Co.—one small bench centering machine, 2½ in. round capacity.

Ill., Peoria—The Bartholomew Co.—3 spindle high duty drill press, with compound table, capacity up to 2 in.

Mich., Detroit—The Detroit Municipal St. Ry. Comn., c/o G. J. Finn, Comr. Purchases and Supplies, Municipal Courts Bldg.—one track welding machine and equipment for welding street railway rails.

Mich., Port Huron—The Great Lakes Fdry. Co., Moar St.—miscellaneous foundry equipment.

O., Cincinnati—The Howe Auto Jack Co., 1520 Race St., J. C. Howe, Purch. Agt.—machine tools, including lathe, drill press and threading machine.

O., Cleveland—The Sterling-Knight Co., Ajax Bldg.—No. 2 Cincinnati or Brown & Sharpe Universal miller with dividing head and all attachments (used).

O., Cleveland—The Waite Taxi and Livery Co., H. F. Hauserman, 1618 Walnut Ave.—one 16 in. x 8 ft. lathe and 16 in. drill press (used).

O., Columbus—The Hayden Automobile Block Machine Co., 891 Michigan Ave.—C. H. Minor, Supt.—additional equipment.

O., Fostoria—The Fostoria Building Supply Co.—
One 48 in. brake.
One 48 in. roller.
One shear.
One ⅜ in. beader.
One large hammer.
One welding outfit.

Wis., Fond du Lac—The Bd. of Educ., c/o A. M. Hunter, Secy.—tools and machinery for vocational school machine shop.

Wis., Milwaukee—The Liberty Vulcanizer Mfg. Co., 656 Madison St.—milling machine and lathe.

Wis., Milwaukee—The Milwaukee Tank Wks., Fratney and Becker Sts.—one set 74 in. bending rolls of ⅝ in. capacity, diam. top roll 7 in., lower roll 6½ in. (new).

Wis., Milwaukee—The Nissen Mfg. Co., 223 Reed St., C. Nissen, Purch. Agt.—drill press.

Wis., Milwaukee—Ramstock & Sons Mfg. Co., 1826 Brown St., F. Ramstock, Purch. Agt.—automatic screw machine.

Wis., Milwaukee—The Res Mfg. Co., 2907 Meinecke Ave., A. Kaufman, Purch. Agt.—punch presses.

Tex., Dallas—The School Bd., C. M. Moore, Secy.—manual training equipment.

Ont., Toronto—Wilson-McGovern, Ltd., Lumsden Bldg.—56 in. or 60 in. x 160 in. grinder for grinding hot mill shear blades.

Machinery Wanted

Md., Baltimore—The Maryland Equipment & Supply Co., Equitable Bldg., H. G. Clark, Purch. Agt.—15 ton locomotive crane with 52 in. magnet and 50 ft. boom, also 7 x 10 Ledgewood or Munday double cylinder with drum (used).

N. Y., New York (Borough of Manhattan)—The Coin Device and Signal Co., Inc., 409 8th Ave.—mach. catalogs on supplies and general equipment.

Pa., Philadelphia—J. F. Shellenberger, Front and Race Sts.—machinery for the manufacture of confectionery.

Va., Richmond—A. Meyer & Son, 114 South 8th St., A. Meyer, Purch. Agt.—one small wood planer (new or used).

Mich., Detroit—The Dept. of Buildings and Safety Engineering, c/o G. J. Finn, Comr. of Purchases and Supplies, Municipal Courts Bldg.—300,000 lb. testing machine for testing structural materials in laboratory of Dept. of Buildings and Safety Engineering.

Wis., Janesville—The Parker Pen Co., East Milwaukee and North Bluff Sts.—oil extractor for removing oil from hard rubber shavings.

Wis., Kenosha—The Morse Granite Co., 310 Church St.—traveling crane.

Wis., Seymour — The Seymour Woodenware Co.—woodworking machinery.

Ariz., Douglas — The Arizona Carpentry and Cabinet Co., 634-40 13th St. — Pony planer and two-slide 12 in. sticker (first class condition, second-hand machinery preferred).

Man., Weston—The Owl Metal Co.—$6,000 worth of machinery.

Ont., Brigden — The Brigden Printing Press—machinery.

Ont., Courtland—I. M. Howe—equipment for sawmill.

Ont., Tilbury—The Tilbury Auto Truck Co.—iron working machinery.

Ont., Timmins—D. Strong—planing mill equipment.

Que., Tartigon—The B. & S. Lumber Co., Fort Plain—machinery.

Metal Working

NEW ENGLAND STATES

Conn., Hartford—M. Delaney, 1075 Main St., plans to build a 1 story, 75 x 100 ft. garage on Albany Ave. Estimated cost, $30,000. F. C. Walz, 407 Trumbull St., Archt.

Conn., Hartford — The Dell Service Station, 266 Wethersfield Ave., will soon award the contract for the construction of a 1 story, 70 x 140 ft. addition to its garage. Estimated cost, $30,000.

Conn., Hartford—A. Goldstein, 593 Windsor St., will build a 1 story, 100 x 110 ft. garage on Maple Ave. Estimated cost, $75,000. Noted Aug. 12.

Conn., Union City (Naugatuck P. O.)—The Eastern Malleable Iron Co. has awarde dthe contract for altering and building additions to its plant. Estimated cost, $50,000.

Conn., West Hartford (Hartford P. O.)—The Hartford Tube Products Co. has awarded the contract for the construction of a 1 story factory with 2 wings, one 30 x 90 ft. and other 30 x 100 ft., on Elmwood St. Estimated cost, $15,000.

Mass., Attleboro—C. L. Rogers, 157 So. Main St., has awarded the contrac for the construction of a 1 story, 60 x 200 ft. garage on Wall St. Estimated cost, $50,000.

Mass., Lawrence—C. W. Dillon, 17 Oxford St., has awarded the contract for the construction of a 1 story addition to his garage. Estimated cost, $10,000. Noted Sept. 9.

Mass., New Bedford — A. Chervais, 54 Sycamore St., will soon award the contract for the construction of a 1 story garage. Estimated cost, $20,000. Private plans.

Mass., New Bedford—E. Colbec, 137 Tinkham St., plans to build a 1 story, 65 x 100 ft. garage, etc., on Bowditch St. Cost between $20,000 and $25,000. O. Crapo, 514 Bowditch St., Archt.

Mass., Springfield—A. Freedman, c/o B. E. Geckler, Archt., 335 St. James Ave., will soon award the contract for the construction of a 1 story, 50 x 60 x 100 ft. garage on Summer Ave. Estimated cost, $35,000.

Mass., Springfield — J. G. Schwenger, 34 Summer Ave., has awarded the contract for the construction of a 1 story garage. Estimated cost, $10,000.

Mass., Whitinsville—The Whitin Machine Wks. plans to build a 4 story, 75 x 200 ft. garage, etc. Estimated cost, $150,000. J. D Leland, 185 Devonshire St., Boston, Archt.

Mass., Worcester — J. Kennedy, 3 Wentworth St., has awarded the contract for the construction of a 1 story garage, etc., on Portland St. Estimated cost, $25,000.

Mass., Worcester — J. Rice, Archt., 306 Main St., is preparing plans for a 2 story, 150 x 180 ft. garage on Pleasant St. Estimated cost, $200,000.

R. I., Providence — The Diamond Land Co., 425 Fountain St., has awarded the contract for the construction of a 1 story addition to its garage on Battery St. Estimated cost, $25,000.

R. I., Providence—W. H. Farrell, Lockwood and Haskins Sts., will soon award the contract for the construction of a 1 story garage and service station. Cost between $12,000 and $15,000.

R. I., Providence—R. T. Slade, 547 Elmwood Ave., has awarded the contract for the construction of a 1 story addition to his garage. Estimated cost, $50,000. Noted Sept. 23.

MIDDLE ATLANTIC STATES

Md., South Baltimore (Baltimore P. O.)—The Baltimore Malleable Iron & Steel Castings Co., Charles and Wells Sts., plans to build additional blast furnaces and install other equipment. Estimated cost, $100,000.

Md., Baltimore — The Del-Mar-Va-Nash-Motors Co., 134 West Mt. Royal Ave., will soon award the contract for the construction of a 3 story, 60 x 150 ft. sales and service station on Maryland Ave. and Oliver St. Estimated cost, $200,000.

N. J., Newark—The Ellis Motor Car Co., 416 Central Ave., has awarded the contract for the construction of a 1 story, 75 x 203 ft. garage on North 6th St. and 1st Ave.

N. Y., New York (Borough of Bronx)—Rubin and Cohn, 406 East 149th St., will build a 1 story, 150 x 220 ft. garage on Jerome Ave. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—F. B. Lynch, 1049 Washington Ave., will build a 1 story, 100 x 125 ft. garage on Montgomery St. Estimated cost, $60,000.

N. Y., New York (Borough of Brooklyn)—M. Moskowitz, c/o J. M. Felson, Archt. and Engr., 1133 Bway., will build a 1 story, 50 x 100 ft. garage on 12th St. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—J. Siris, 206 Bway., will build a 1 story garage on Nostrand and Willoughby Aves. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—J. Bernstein, 1430 Madison Ave., will build a 1 story, 100 x 165 ft. garage on Boston Post Rd. Estimated cost, $75,000.

N. Y., New York (Borough of Manhattan)—The Coin Device & Signal Co., Inc., 409 8th Ave., plans to enlarge its factory.

N. Y., New York (Borough of Manhattan)—J. Ruppert, Inc., 1639 3d Ave., is having plans prepared for the construction of a 2 story, 50 x 200 ft. auto repair shop at 243 East 90th St. Estimated cost, $50,000. Maynecke & Franke, 25 East 26th St., Engrs. and Archts.

N. Y., New York (Borough of Manhattan)—The Transit Comn., 49 Lafayette St., will soon award the contract for the construction of additional shops at Lenox Ave. and 148th St. yards.

N. Y., New York (Borough of Manhattan)—J. Zimmerman, 557 East 160th St., will build a 1 story, 100 x 130 ft. garage on Fordham Rd. Estimated cost, $50,000.

N. Y., Buffalo—The Amer. Car & Fdry. Co., 370 Babcock St., has awarded the contract for the construction of a 2 story, 35 x 46 x 74 ft. addition to its factory. Estimated cost, $40,000.

N. Y., Buffalo—The Buffalo Fdry. & Machine Co., 1543 Fillmore Ave., has awarded the contract for the construction of a 2 story, 50 x 70 ft. pattern shop. Estimated cost, $25,000.

Pa., Tabor (Philadelphia P. O.)—The Fox Motor Car Co., Broad and Huntingdon Ave., has awarded the contract for the construction of a 3 story, 60 x 400 ft. automobile plant on Grange Ave. along tracks of Reading R.R. Estimated cost, $500,000.

Pa., Reading—The Gray Iron Fdry. Co. is building a 60 x 360 ft. factory for the manufacture of "Keystone" concrete machinery.

MIDDLE WEST

Ind., Marion—The Marion Insulated Wire & Rubber Co. is building a 30 x 50 ft. rubber insulated wire plant. J. F. Auten, Gen. Mgr.

Mich., Detroit—The Blodgett Engineering and Tool Co., Kerr Bldg., has awarded the contract for the construction of a 4 story factory on Dalzelle St. Noted Aug. 19.

Mich., Marysville—The Aluminum Castings Co., 2800 Harvard Ave., Cleveland, Ohio, plans to build a 2 story factory here. Estimated cost, $75,000. E. E. Allyne, Pres. Private plans.

Mich., Port Huron — The Great Lakes Fdry. Co., Moar St., has awarded the contract for the construction of a 1 story, 50 x 95 ft. foundry. Estimated cost, $15,000.

O., Cleveland — The Fageol Motors Co., c/o S. Regar, of Chandler Motor Co., East 131st St. and St. Clair Ave., plans to build a 3 story factory. Estimated cost, $200,000.

O., Cleveland — The Natl. Refining Co., Rose Bldg., has awarded the contract for the construction of a 1 story, 60 x 121 ft. machine shop and service building at 3330 East 87th St. Estimated cost, $30,000.

O., Dayton—The Central Motor Co., Main and Apple Sts., plans to build a 2 story, 80 x 145 ft. factory on 3d and Horace Sts. Estimated cost, $100,000.

Wis., Cedarburg — The Auto-Life Chain Co., c/o F. Hoya, 231 37th St., Milwaukee, has awarded the contract for the construction of a 1 story, 60 x 120 ft. factory on Main St. here for the manufacture of tire chains. Estimated cost, $50,000.

Wis., Fond du Lac — The Bd. of Educ., c/o A. M. Hunter, Secy., will soon award the contract for the construction of a 3 story, 66 x 261 ft. senior-junior high school, to contain a machine shop. Estimated cost, $500,000.

Wis., Kenosha—City will soon award the contract for the construction of a 1 story, 60 x 107 ft. garage on Strong St.

Wis., Kohler—The Kohler Co. will build a 3 story, 62 x 148 ft. factory and foundry.

Wis., Manitowoc—The Clark Oil Co., 10th St., has awarded the contract for the construction of a 1 story, 60 x 100 ft. garage, filling station, etc., on 10th and York Sts. Estimated cost, $100,000. Noted Aug. 19.

Wis., Milwaukee—The Natl. Brake and Electric Co., Belleview Pl., has awarded the contract for the construction of a 1 story, 164 x 180 ft. addition to its foundry. Estimated cost, $250,000. Noted May 6.

Wis., Neillsville—The Neillsville Auto Co. will soon award the contract for the construction of a 1 story, 90 x 120 ft. garage. Balch & Lippert, Madison, Archts.

WEST OF THE MISSISSIPPI

Kan., Columbus—Cherokee County plans election to vote on $60,000 bonds to build and equip a machine shop addition to high school. G. Cooper, County Engr.

Kan., Topeka — The Topeka Fdry. and Iron Co., 318-22 Jackson St., plans to construct a foundry, machine shop and structural shops. Estimated cost, $100,000.

Kan., Wichita—The Wichita Clear Vision Pump Co., 1107 East Douglas Ave., plans to build a 70 x 320 ft. gasoline pump factory on Harry St. between Mosley and Mead Aves. Estimated cost, $500,000. E. Crouse, Pres.

Kan., Wichita—The Wichita Visible Gasoline Pump Co., 701-15 Gilbert St., plans to construct a pump plant, to include a complete machine shop and tank construction building. Estimated cost, $100,000. R. A. Jacobs, Pres.

Minn., Buffalo—E. T. Schmidt plans to build a 1 story, 60 x 95 ft. garage. Estimated cost, $20,000. Graham & Swain, 1227 Plymouth Bldg., Minneapolis, Archts.

Minn., Northfield—Melounck & Machacek are building a 1 story, 40 x 150 ft. foundry and machine shop on North Water St.

Mo., Springfield—The Wood Everett Stove Co. plans to build a 2 story foundry. Estimated cost, $100,000.

S. D., Woorsocket—Staake Bros., Mitchell, plan to build a 1 story, 50 x 142 ft. garage here. Estimated cost, $20,000. H. C. Gabele, Mitchell, Archt.

CANADA

Ont., London—The London Concrete Machinery Co., Cabell Ave., will soon award the contract for the construction of a 3 story, 70 x 100 ft. factory. Estimated cost, $100,000. Private plans.

Ont., Tilbury—The Tilbury Auto Truck Co. will soon award the contract for the construction of a 3 story, 60 x 135 ft. factory. Estimated cost, $80,000.

Que., Montreal — The Canada Motor and Machinery Co., Laganchitiere St., has awarded the contract for the construction of a garage and repair shop. Estimated cost, $42,000.

Que., Montreal — T. Davidson Mfg. Co., Deslisle St., manufacturers of tinware, plans to build a 4 story, brick and steel extension on Deslisle, Workman and Albert Sts.

General Manufacturing

NEW ENGLAND STATES

Conn., Bridgeport—The La Resista Corset Co., 32 Norman St., will build a 1 story garage. Estimated cost, $10,000.

Conn., Newtown—H. Curtiss & Sons Co., Sandy Hook, will soon award the contract for the construction of a 1 story, 30 x 40 ft. and a 1 story, 50 x 80 ft. factory, with 30 x 40 ft. ell, on Foot Rd. for the manufacture of paper boxes. Estimated cost, $30,000. Sunderland & Watson, 248 Main St., Danbury, Archts. Noted Sept. 2.

Conn., Versailles—The Versailles Sanitary Fibre Mills has awarded the contract for the construction of an addition to its paper factory. Estimated cost, $100,000.

Conn., Waterbury—The Waterbury Lumber Co., Inc., 107 Meadow St., has awarded the contract for the construction of additions to its plant. Estimated cost, $50,000.

Maine, Lisbon Falls—The Worumbo Mfg. Co. plans to build an addition to its textile factory. Estimated cost, $100,000.

Maine, Waterville—The Keyes Fibre Co. has awarded the contract for the construction of a 1 story paper factory. Estimated cost, $100,000.

Mass., Boston—S. Simmonds, 21 Bromfield St., will build a 2 story, 26 x 50 ft. factory on Washington St. for the manufacture of wool. Estimated cost, $15,000.

Mass., Cherry Valley (Leicester P. O.)—The Chapel Mills Mfg. Co. has awarded the contract for the construction of a 2 story, 43 x 112 ft. factory for the manufacture of flannels. Estimated cost, $50,000.

Mass., East Pepperell—The Nashua River Paper Co. plans to build an addition to its plant. Estimated cost, $100,000.

Mass., Fall River—The Amer. Printing Co., 56 Water St., will construct a 2 story, 80 x 87 ft. cloth building on Water St. Estimated cost, $50,000.

Mass., Holyoke—The Perfect Safety Paper Co., Winter St., plans to build a 60 x 100 ft. addition to its paper factory on Appleton and Winter Sts. Cost between $75,000 and $100,000. Howes & Howes, 243 High St., Archts.

Mass., Norwood—The Holliston Mills, Lenox Ave., has awarded the contract for the construction of a 2 story, 136 x 280 ft. textile factory and 1 story, 50 x 70 ft. boiler house. Estimated cost, $300,000. Noted Sept. 9.

Mass., South Barre—The Barre Wool Combing Co. has awarded the contract for the construction of a wool factory. Estimated cost, $50,000.

N. H., Salem—C. O. Siegert, 12 White St., Haverhill, Mass., plans to build a 1 and 2 story, 50 x 100 ft. bottling plant here. Estimated cost, $25,000. J. E. Allen, 283 Essex St., Lawrence, Mass., Archt.

R. I., Pawtucket—The Hope Webbing Co., 1005 Main St., will soon award the contract for the construction of a 1 story addition to its textile mill. Estimated cost, $100,000. Perry & Whipple, Rhode Island Hospital Trust Bldg., Providence, Engrs. and Archts.

Vt., Northfield—The Northfield Creamery has awarded the contract for the construction of a 2 story, 55 x 62 ft. creamery. Estimated cost, $25,000.

MIDDLE ATLANTIC STATES

Del., Wilmington—The Wilmington Sugar Refinery Co. plans to build a refinery. Estimated cost, $2,000,000. W. Higginson, 18 East 41st St., New York City, Engr. and Archt.

Md., Baltimore—The U. S. Printing & Lithographing Co., 429 East Cross St., has awarded the contract for the construction of a 3 story, 128 x 129 ft. addition to its plant on Cross and Covington Sts. Estimated cost, $150,000.

N. J., Hoboken—The Chocolate Mainer, 1127 Clinton St., will build a 2 story factory. Estimated cost, $100,000. Noted Aug. 16.

N. Y., Lockport—The Lockport Felt Co. has awarded the contract for the construction of a 1 story, 80 x 200 ft. factory. Estimated cost, $80,000.

Pa., Philadelphia—E. Hubschman, Orianna and Willow Sts., has awarded the contract for the construction of a 1 story, 60 x 90 ft. addition to its leather factory. Noted July 27.

Pa., Philadelphia—McIlvain Bros., 15th and Hamilton Sts., will soon award the contract for altering their drug factory.

Pa., Philadelphia—Rinald Bros., 1142 Hancock St., have awarded the contract for the construction of a 2 story, 46 x 55 ft. varnish factory on Grove and Wharton Sts. Noted Sept. 16.

Pa., Philadelphia—J. F. Shellenberger, Front and Race Sts., will soon award the contract for the construction of a 5 story, 57 x 66 ft. confectionery factory at 107 Race St. A. B. Lacey, 1012 Walnut St., Archt.

Pa., Pittsburgh—The Rieck McJunkins Co., 1345 Forbes St., has awarded the contract for the construction of a 4 story, 30 x 100 ft. dairy on Stevenson and Forbes Aves. Estimated cost, $100,000.

Pa., Pittsburgh—The Weinstein Beverage Co., 646 5th Ave., has awarded the contract for the construction of a 3 story, 48 x 110 ft. warehouse and factory on Hamilton Ave. Estimated cost, $100,000.

SOUTHERN STATES

La., Pontchatoula—The Universal Folding Crate Co., Inc., 601 Bourbon St., New Orleans, is having plans prepared for the construction of a 2 story, 50 x 100 ft. factory here for the manufacture of folding crates and boxes. Estimated cost, $30,000. J. J. Dahlstrom, Vice-Pres. and Archt.

MIDDLE WEST

Mich., Detroit—The Consolidated Cigar Co., St. Aubin Ave., has had plans prepared for the construction of a 3 story, 92 x 100 ft. cigar factory. Estimated cost, $90,000. A. Kahn, Marquette Bldg., Archt.

Mich., Ontonagon—The Northern Fibre Co. has awarded the contract for the construction of a 2 story pulp mill. Estimated cost, $350,000.

O., Akron—The Miller Rubber Co., South High St., will build a 3 story, 60 x 210 ft. factory. Estimated cost, $100,000. J. A. Stevens Co., Frederick Bldg., Cleveland, Engrs. and Archts.

O., Cleveland—Aetna Provision Co., c/o Best & Hoefer, Archts., Vickers Bldg., is having plans prepared for the construction of a 2 story, 36 x 76 ft. factory on Aetna Rd. Estimated cost, $30,000.

O., Cleveland—The Peerless Motor Car Co., East 93d St. and Quincy Ave., plans to construct a 1 story, 60 x 100 ft. japaning building. Estimated cost, $100,000.

O., Lorain—J. C. Newman Cigar Co., 3830 Woodland Ave., Cleveland, has awarded the contract for the construction of a 3 story, 30 x 62 ft. addition to its factory here. Estimated cost, $30,000.

O., Toledo—The Maumee Tire and Rubber Co., 705 Madison Ave., is having plans prepared for the construction of a 3 story, 100 x 300 ft. rubber tire factory on Lackey Rd. Estimated cost, $300,000. S. S. Morrison, Pres. Osborn Eng. Co., 2848 Prospect Ave., Cleveland, Engrs. and Archts.

Wis., Fond du Lac—The Fountain City Ice Cream Co., 218 South Main St., is having plans prepared for a 2 story, 60 x 180 ft. dairy plant on Division St. Estimated cost, $80,000. B. E. Mehner, 6 East Division St., Archt.

Wis., Marathon—The Wausau Canning Co., Wausau, plans to build a 4 story canning factory on Main St. here. Estimated cost, $50,000.

Wis., Merton—The Merton Dairy Products Mfg. Co. has awarded the contract for the construction of a 2 story, 30 x 200 ft. dairy products factory on Main St. Estimated cost, $30,000. Noted Sept. 23.

Wis., Muscoda—The Muscoda Mfg. Co. will soon award the contract for the construction of a 2 story, 75 x 100 ft. furniture factory on Main St. Estimated cost, $50,000. Noted April 22.

Wis., Sheboygan—The Columbia Rubber Mills, 176 16th St., has awarded the contract for the construction of a 2 story, 60 and 70 x 100 ft. factory. Estimated cost, $60,000. Noted Aug. 19.

Wis., West Bend—The Schmidt & Storck Wagon Co. will soon award the contract for the construction of 1 story, 100 x 300 ft. factory. Buemming & Guth, 521 Jackson St., Milwaukee, Archts. Noted Sept. 16.

WEST OF THE MISSISSIPPI

Kan., Chanute—The Mutual Oil Co., Mutual Bldg., Kansas City, Mo., will build a 3 story, 35 x 90 ft. wax and lubricating oil plant here to replace one which was recently destroyed by fire. Estimated cost, $100,000.

Minn., Hamline—The Minnesota State Agricultural Society, c/o T. Canfield, Secy., Como Ave. near Snelling Ave., St. Paul, Minn., plans to build a 2 story addition to its dairy on State Fair Grounds here. Estimated cost, $200,000. C. H. Johnston, 715 Capitol Bank Bldg., St. Paul, Archt.

Mo., St. Louis—The Scott Dyeing and Cleaning Co., 3928 Olive St., is having plans prepared for the construction of a 2 story, 58 x 160 ft. cleaning plant. Estimated cost, $50,000. H. P. Hess, 4811 Cote Brilliante Ave., Archt.

Mo., Webb City—The Rock Paint & Cloth Co. is having plans prepared for the construction of a 2 story, 61 x 150 ft. paint factory. Estimated cost, $150,000. Bucy-Miller Eng. Co., Joplin, Mo., Engrs.

Iowa, Cedar Rapids—The Dysort Nickol Candy Co. has awarded the contract for the construction of a 3 story, 40 x 70 ft. factory. Estimated cost, $30,000.

Minn., Minneapolis—The Franklin Co-operative Creamery Co., c/o E. Solem, 11½ Western Ave., will build a 1 story, 64 x 85 ft. creamery on 26th St. and Franklin Ave. Estimated cost, $50,000.

N. D., Minot—The Minot Steam Laundry plans to build a 2 story, 87 x 140 ft. steam laundry. Estimated cost, $85,000.

Okla., Daugherty—The Continental Asphalt & Refining Co., Oklahoma City, will build a refinery here. Estimated cost, $1,000,000.

Tex., Dallas—The School Bd. will soon award the contract for the construction of a 3 story high school on Haskell and McKinney Sts. to contain a manual training department. Estimated cost, $600,000. C. M. Moore, Secy. W. B. Ittner, Bd. of Educ. Bldg., St. Louis, Mo., Archt.

WESTERN STATES

Cal., San Francisco—The Federal Rubber Co., Cudahy, Wis., will soon award the contract for the construction of a 5 story factory here for the manufacture of tires, etc.

CANADA

B. C., Howe Sound—The Western Canada Pulp & Paper Co. will soon award the contract for the construction of a plant for the manufacture of lumber, shingles and wood products.

Ont., Courtland—I. M. Howe plans to build a sawmill.

Ont., Ottawa—The Ottawa Paint Wks., 687 Wellington St., has awarded the contract for the construction of a 3 story factory. Estimated cost, $50,000.

Ont., Stratford—The Kindel Bed Co., Ontario St., has awarded the contract for the construction of a 3 story furniture factory. Estimated cost, $30,000.

Que., Montreal—The National Drug and Chemical Co., 34 St. Paul Ave., has awarded the contract for the construction of a factory on De Courcelles St. Estimated cost, $75,000. Noted July 1.

Que., Montreal—The Rena Footwear Co., Ltd., 611 Beaudry St., plans to build an addition to its plant.

Que., Montreal—The Simond Canada Co., Ltd., 95 St. Remi St., has awarded the contract for the construction of a 2 story sawmill on Acorn St. Estimated cost, $29,000.

Que., Tartigon—The E. and S. Lumber Co., Fort Plain, will erect two mills here, one 47 x 140 ft. and other 30 x 60 ft.

MEN THAT FIT JOBS THAT FIT **SEARCHLIGHT SECTION**

See Pages 278 to 305 *"For Every Business Want"* See Pages 278 to 305